A MULTI-LEVEL GOVERNANCE APPROACH TO UNDERSTANDING FRAGMENTATION IN THE IMPLEMENTATION OF STORMWATER POLICIES

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This dissertation argues that stormwater management is fragmented both at that vertical fragmentation (at the level of intergovernmental relations) and horizontal fragmentation (within the level of governments). The first essay focuses on the institutional arrangements used by states to implement stormwater management policies. Building on the race to the bottom literature, I examine the impact of the institutional arrangement centralization on state water quality in California, Texas, Virginia, and Minnesota. A five-year (2013-2018) permitting cycle was used to analyze five dimensions: formalism, coercion, education, prioritization, and accommodation.There is an inverse relationship between the quality of stormwater and the degree of centralization in the institutional arrangements adopted by state governments to implement their stormwater management policies. The second essay focuses on a local government's decision to join an inter-local agreement to comply with federal/state stormwater management policies. Building on the transaction cost framework, the study used a cross-sectional design to analyze a case study. The case study consists of 119 cities subjected to stormwater regulation requirements in northern Texas during 2017. The dependent variable is the membership of the regional inter-local agreement, and the independent variables are the number of neighboring cities and population density. Community wealth, public works spending, stormwater fees, government type, and the percent of the population over 65 were used as control variables. Logistic regression was used for data analysis. This study concludes that the increase in the number of neighboring regulated local governments is associated with an increase in the likelihood of a decision by the regulated local government to join an interlocal agreement

(ILA), as well as finding that an increase in the population density is associated with an increase in the likelihood of a decision by the regulated local government to join the ILA. In addition, the study found that the type of government also affects a decision to enter into a cooperative relationship to meet the regulative burdens associated with implementing the stormwater management policies imposed by state/federal governments. The results found in this dissertation contribute to bridging the gap in our knowledge on the impact of the institutional framework adopted by the states to implement environmental policy through empirically evaluating the effect of institutional arrangements (as represented in the States general MS4 permits) on the policy output (reducing the level of stormwater pollution).

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CHAPTER 1

INTRODUCTION

Public policy implementation has received extensive attention in the research literature, especially regarding achieving public policy goals in light of institutional fragmentation. According to Farhang and Yaver (2016), the implementation of public policies in the United States of America is characterized by being scattered between several institutions and actors, making it possible to increase the contradiction and reduce the opportunities for joint work. In other words, the responsibility for implementing public policies is distributed among different levels of government (federal, state, and local governments), which in turn need to work jointly at the vertical and horizontal levels to avoid opportunistic behavior and negative externalities. Therefore, dealing with collective action problems does not depend merely on understanding the ecological characteristics and solutions related to the problem; rather, it also includes the institutional framework in which decisions are made, and solutions to the problem are selected and then implemented. Institutions can be defined as the rules that govern political decisions (Bickers & Williams, 2001). According to North (1991), "[i]nstitutions are the humanly devised constraints that structure political, economic, and social interaction" (p. 97). In this sense, institutions are designed to direct members' behavior with collective action problems through formal or informal rules. However, institutions are fragmented. According to Biermann, Pattberg, and Asselt (2009, cited in Zelli, 2015, p.469), institutions can differ "in their character (organizations, regimes, and implicit norms), their constituencies (public and private), their spatial scope (from bilateral to global), and their [predominant] subject matter." In other words, there is no specific framework or type of institution that affects public policies.

On the contrary, the institutional frameworks and their components differ according to

the policy domain under consideration. In the field of environmental policies related to water, Adler (1994, cited in Adler, 2009a) identified sources of institutional fragmentation in the water policy domain that includes vertical fragmentation (at the level of intergovernmental relations) and horizontal fragmentation (within the level of governments). The term vertical fragmentation refers to the number of levels of government (federal, state, and local government) that overlap in their responsibilities, interests, and goals that they aim to achieve. The term horizontal fragmentation refers to the nature of the relationship between government units at the level and unit (a state with state or one local government with another).

Concerning the vertical fragmentation, over the past century and continuing to the present, there have been many developments in intergovernmental relationships between governments in the federal system. Accordant to Shafritz, Russell, and Borick (2010), the dynamics of the intergovernmental relationship in the US federal framework can be seen from four viewpoints. The first viewpoint is dual federalism, which asserts that federal and state governments are theoretically distinct and separate. The second viewpoint is cooperative federalism, which argues that the national, state and local governments cooperate as interacting agents, working to solve common problems rather than conflicting. The third viewpoint is that of creative federalism, which is characterized by a focus on joint planning and decision-making among all levels of government in the management of intergovernmental programs. The final viewpoint is layer cake federalism, which sees federalism as involving the assignment of responsibilities to different government levels, namely, national, state, and local government. State governments have responsibility for public safety, education, and social welfare, among other concerns, while the national government's responsibilities include national security and regulation of inter-State commerce. Regardless of the perspective on the federal relationships,

the local government is recognized as the unit responsible for the enforcement of a wide range of policies issued by the federal and state governments. Therefore, local governments cannot be seen as separate units operating outside the framework of intergovernmental relations.

Concerning the implementation of public policies in light of the vertical fragmentation at the level of intergovernmental relations, Lyons and Lowery (1989) stated that there are two views on dealing with this fragmentation. The first viewpoint to the need for centralization of authority to enhance the efficiency and effectiveness of policy implementation by reducing the number of actors or units associated with an implementation process (Lyons and Lowery, 1989). The second point of view stems from local public economies, which argues for the importance of decentralization to provide opportunities for citizens to choose the basket of services that suits their orientations and individual needs. Thus, one fundamental proposition of the theory of local public economies is that the degree of centralization or decentralization in institutional arrangements affects the output of the policy within the vertical fragmentation at the level of intergovernmental relations.

In addition to the influence of centralization or decentralization in institutional arrangements at the vertical fragmentation level, the implementation of public policies is influenced by the relationship between governments at the horizontal level. The regulations and standards imposed by the higher authorities can turn into regulatory burdens on the local governments. According to Esty (2016), compliance with the regulations and standards of the Department of Energy and Environmental Protection Agency and their counterpart in the States is associated with a cost paid either by the individual users or the local entities. Similarly, Conlan, Riggle, and Schwartz (1995) argued that the Unfunded Mandate Reform Act of 1995 increased the already existing regulatory burdens on state and local governments by inserting

enforceable duty on them without coverage of expenses. In addition, Conlan, Riggle, and Schwartz (1995) stated that this unfunded mandate could cause state and local governments billions of dollars in compliance. The regulated local governments that the federal/state government requires to meet certain standards to comply with an unfunded mandate look for ways to reduce compliance costs. Therefore, local governments need to cooperate to meet the regulatory burdens of implementing public policies and achieve public policy objectives.

Given the vertical and horizontal fragmentation of implementing public policies, this dissertation aims to build a conceptualization of a multilevel governance framework that accounts for the complexities of implementing stormwater management policies, by answering two questions:

> Q1: How do the institutional arrangements adopted to implement stormwater policies influence variation in stormwater quality at the state level?
>
> Q2: What influences variation in interlocal agreement (ILA) membership for stormwater regulatory compliance at the regional level?

The first question addresses the implementation of stormwater management policies at the vertical level, while the second deals with the cooperation between local governments to comply with federal/state stormwater management policies at the horizontal level. The proposed conceptual framework facilitates an understanding of the complexities of implementing stormwater management policies at vertical and horizontal levels. In addition, the proposed conceptual framework adds the horizontal level to the polycentric approach, which is widely used to explain decentralized environmental policies (Homsy, Liu, & Warner, 2019).

1.1 Defining the Collective Action Dilemma of Stormwater

Attention to stormwater pollution is recent compared to other types of pollution resulting from human activity. According to Novotny (1995), environmentalists and governments first

became aware of the extent to which stormwater has polluted water resources during the 1960s and 1970s. During that period, parties interested in the issue of water quality became perplexed when the standards and legislation concerned with the treating of sewage water failed to reduce the level of pollution and raise the quality of water. It became apparent that there was another source of water pollution that was no less dangerous than sewage or the pollution resulting from factories discharging their waste into water bodies. Attention turned later to an investigation of the issue of stormwater and its impact on water pollution levels. Stormwater itself is part of the process of the water cycle in nature. The water cycle, in general, is manifested by the evaporation of water: the evaporated water turns into clouds, the clouds move and then become rain, and the rain runs in its natural paths and finally returns to the water surface. However, human intervention in this natural water cycle has made stormwater a threat to nature and society.

The management of stormwater represents a collective action dilemma. First, it is necessary to define the concept of the social dilemma. Ostrom (1998) stated that a social dilemma occurs when individuals make short-term gains at the expense of the group's total gains. Therefore, in any setting that requires a collective action (a group effort to achieve a common outcome), a social dilemma will be present. Working from this definition, stormwater can be understood as representing a collective action dilemma in two respects. The first aspect of the stormwater collective action dilemma relates to maintaining the quality of water free from stormwater pollution. The collective action dilemma associated with benefiting from watersheds is well documented in the literature (Cowie & Borrett, 2005; Ostrom, 1990; Berardo & Scholz, 2010). However, stormwater threatens the quality of water in these watersheds; thus, when no actor takes measures to reduce the contamination of the stormwater that flows into a water body,

all members who benefit from this body will suffer from the negative externalities. The collective action dilemma here is represented by the failure of one member to reduce stormwater pollution, leading to the whole group's suffering the consequences.

The other aspect of the stormwater collective action dilemma lies in the way stormwater is managed. According to Welty (2009), most local governments focus on transporting stormwater beyond their geographical boundaries as quickly as possible, which results in increasing the volume of the water transported toward the downstream neighboring local governments; thus, the downstream neighbors must deal with the negative externalities produced by the upstream cities' decisions. In other words, the decision of local governments to employ drainage networks that are highly effective and efficient in transporting water can increase the power and rate of the flow of water into the areas administered by neighboring governments. This, in turn, may lead to flooding or to the transfer of harmful waste from the source to the neighboring governments' areas. The issue of stormwater pollution and stormwater management have direct impacts on both the environment and society.

1.1.1 The Impact of Stormwater on the Environment

Most studies related to the negative effects of stormwater on the environment in the 1980s (a time which saw the beginning of legislative solutions to the problem at the national level) indicated stormwater is responsible for a high proportion of the pollution of water bodies in the United States. For example, Cunningham (1988) found that stormwater was responsible for over 75% of water pollution (cited in Novotny, 1995). As recently as 2017, the U.S. Environmental Protection Agency (USEPA) reported that 46% of rivers/streams and 21% of the nation's lakes were in a poor condition due to stormwater and other pollution sources such as agriculture and urban development. These figures show that stormwater affects the

environmental formation surrounding water bodies. Pollution carried by stormwater or melted snow water affects water bodies' chemical, biological, and physical properties (Baker, 2009a). Regarding chemical and biological considerations, pollutants carried by stormwater to water bodies affect the natural composition of these surfaces; thus, these polluted water bodies become unsupportive of the natural cycle. This, in turn, may affect the number of living creatures that inhabit these bodies of water, such as fish. In addition, polluted lakes may affect the surrounding environment. For example, pollution might contribute to the poisoning of animals that drink polluted water or feed on creatures that live in this water.

Furthermore, the pollution caused by stormwater increases the speed of evaporation of water in water bodies, which may lead to their shrinkage or to dryness in the environment (Baker, 2009b). According to Novotny (1995), it is difficult to completely understand the full impact of stormwater pollution on the environment since the core of the problem lies in the stormwater management process. Therefore, the negative externalities of pollution caused by stormwater may exceed the indications of current reports on the subject.

1.1.2 The Impact of Stormwater on Society

The negative externalities of pollution caused by stormwater impact society in three areas: drinking water, floods, and property destruction. The USEPA report (2017) indicates contaminated water bodies are unsupportive for human activities such as fishing or swimming. However, the real danger lies in threats to drinking water supplies. Indeed, half of the rivers and one-fifth of the lakes in the U.S. have become unsuitable for drinking; thus, local governments must search for new sources to supply their communities with drinking water. In addition, the decrease in drinking water sources will increase the cost of water to local governments and society. The problems affecting drinking water may not be a direct result of stormwater

pollution, by contrast with flooding, which is a direct result of stormwater. With the decline of natural drainage systems, many American cities found themselves trapped by severe flooding waves during the first half of the 20th century (Baker, 2009b). According to Welty (2009), most cities have focused on transporting stormwater beyond their geographical boundaries as quickly as possible, which has resulted in an increase in the volume of the water moving toward the downstream cities; thus, the downstream cities have had to deal with negative externalities produced by the upstream cities' decisions. This stormwater also directly affects property through the process of displacing soils. The strength and volume of stormwater can cause the slipping of soil, which in turn may affect property values (Braden & Johnston, 2004). As property prices decrease, local governments lose part of their income through decreases in property tax. In light of these negative externalities affecting the environment and society, it is imperative to investigate effective and efficient stormwater pollution management.

1.1.3 Causes of Stormwater Problems

1.1.3.1 Urban Development

The relationship between urban development and environmental impacts is unmistakable. American cities have witnessed an increase in the urban population during the Industrial Revolution and the stages that followed. Migration to cities has multiplied over the past century. According to the Center for Sustainable Systems (2019), about 80% of the U.S. population lives in urban cities, and this proportion is expected to reach 90% by the year 2050. The increase in the urban population has led to an increase in urbanization and construction in cities. Urban areas include housing, commercial or government buildings, and factories, along with the transportation networks that connect these units. Various building activities have brought about fundamental changes in the natural landscape.

Natural ecosystems have solutions to deal with stormwater. However, with the increase of urban development and road building, many wetlands and vegetated floodplain habitats have been lost (Bledsoe & Booth, 2009). According to Bledsoe and Booth (2009), the loss of natural drainage systems creates multiple problems. For example, non-alluvial channels (routes constructed specifically by cities to transport stormwater) increase water transfer speed and reduce the absorption of stormwater to groundwater. In addition, natural drainage systems can filter some types of debris, such as rocks or falling trees. However, with the increase of urbanization, there has been an increase in chemical debris, which is difficult to deal with naturally and threatens to contaminate surface water (Bledsoe & Booth, 2009).

Furthermore, the National Stormwater Quality Database (compiled with support from the EPA) reported in 2018 that all rain samples collected from six types of urban land use (freeways, industrial sites, open space areas, and residential, commercial, and institutional sites) contained environmental pollutants. According to the National Stormwater Quality Database—NSQD project report (2018), the size and type of pollution varies from site to site. For example, roads are at the forefront of pollution sources containing copper; however, we find that open areas are the greatest sources of soil pollution (NSQD, 2018).

1.1.3.2 Stormwater Discharge Without Treatment

Many American cities had already adopted standards to deal with sewage water before the federal government took legislative measures to ensure that sewage was treated before it was pumped into nature again (Winter, 1993). The Clean Water Act (1972) provided funds and required the creation of publicly-owned treatment works (POTWs); the act contributes to treating sewage water and maintaining water quality. According to the USEPA (2016), "[a]s of January 1, 2012, 14,748 publicly-owned wastewater treatment plants were serving 238.2 million

Americans, or 76 percent of the population" (p.25). However, there is less stormwater regulation: approximately 7,450 local governments discharge stormwater without treatment (USEPA, 2016, p. 20). These local governments collect stormwater through drainage systems separate from the sewage treatment system. Drainage networks serve to transport water and re-pump it into the torrential streams of stormwater, transporting it into water bodies.

Two important consequences result from discharging stormwater without treatment. The first effect is the transport of pollutants carried by stormwater into water bodies. All construction, chemical, or sensory waste, scavenging, and pesticides used in home gardens will be swept away by stormwater into water bodies. The other consequence is an increased probability of flooding. According to Bledsoe and Booth (2009), the drainage networks built to transport stormwater contributes to increasing the strength and speed of the stormwater flow; thus, they may increase the water overload of the receiving water body. In other words, the more effective the stormwater drainage networks are in the process of transportation and the speed of transport, the greater the likelihood of flooding due to the increased levels of water bodies is. In contrast, natural drainage systems can slow down the flow of stormwater, which will allow the water surface to gradually absorb the excess stormwater, thus reducing the possibility of floods. The following section turns to the history of efforts made by governments to deal with the negative effects of stormwater.

1.2 Fragmentation of Stormwater Policy Solutions Across Levels of Governance

In the important study of stormwater management, three problems have been recognized as essential: limiting pollution of stormwater to surface water, regulation of the stormwater management practices of local governments, and the joining of horizontal solutions to manage the stormwater problem. Each of these areas is related to a specific dimension of the problem of

stormwater. Beginning with the quality of stormwater, it is clear that finding an effective means to raise the quality of stormwater is essential to reduce stormwater pollution of surface water. In addition, local governments are responsible for providing stormwater management services; therefore, they must adopt effective plans to deal with the problem. Likewise, local governments must cooperate to control the downside of stormwater management and increase the efficiency of dealing with the problem by reducing redundancy in implementing solution efforts. Considering the previously mentioned dimensions, we find that the history of dealing with the problem of stormwater can be framed in terms of the local response, the response at the level of state governments, and the response at the federal government level.

1.2.1 Local Policy Solutions

Historically, local governments have been responsible for dealing with issues that concern their citizens. Regarding the problem of stormwater, local governments have varied in their treatment of the issue, taking two opposing approaches. According to Adler (2009b), local governments have used either “civil law” or the notion of the “common enemy” to deal with the issue of stormwater drainage. Under the “civil law” approach, property owners cannot make changes in the natural streams on their land without bearing the cost of all the damage caused by the changes; thus, owners' ability to construct stormwater drainage systems has been restricted. In contrast, local governments that follow the “common enemy” approach allow landowners to make any changes to the water course in their lands, regardless of the damage, as long as it is not intentional. Both methods are applied through local ordinances related to zoning or construction permits (Adler, 2009b).

However, local governments (in states that did not adopt solutions to the problem and before the solutions adopted by the federal government were implemented) did not pay attention

to the negative effects of stormwater pollution. According to Tyer (1993), local governments have focused on building roads and service facilities for residents without stormwater management. At the beginning of the last century, it became clear to local governments that stormwater threatened people's lives through the rise of the water level of rivers and the disruption of transportation networks (Welty, 2009). In searching for quick solutions to the problem, some local governments have established stormwater drainage networks connected to sewage systems, contributing to increases in the pollution of water bodies (Adler, 2009b). The poor performance of local governments in dealing with stormwater problems led some states to form their own policies before the federal government intervened to solve the problem.

1.2.2 State Policy Solutions

A group of states took measures to deal with water quality in general and stormwater management in particular. For example, some northern states (such as New York, Pennsylvania, and New Jersey) adopted policies that regarding pollution pumping by factories and sewage networks in the mid-1920s (Paavola, 2006). On the other hand, the problem of stormwater management was recognized in a limited number of states. Among these states, California was one of the first to adopt legislation to deal with stormwater. In 1949, California adopted the Dickey Water Pollution Act, which established the State Water Pollution Control Board (SWRCB) and nine Regional Boards to oversee and enforce the State's pollution prevention and abatement program (Water Education Foundation, 2013). The SWRCB was responsible for enforcing the State's pollution program. In addition, California instituted the Porter-Cologne Water Quality Control Act of 1969, which increased the power of the SWRCB regarding pollution prevention. The California SWRCB has become a major player in implementing federal stormwater management policies.

However, Tyer (1993) stated that state governments had not had an effective role in finding legislative solutions to stormwater pollution. The ineffective role of the states may be attributed to the fact that most states were concerned with reducing costs for taxpayers and businesses. The passing of any legislation related to managing stormwater meant an increase in cost to the state's citizens. Therefore, most of the states depended on the practices followed by local governments to deal with stormwater. This variation in the states' roles in dealing with water pollution prompted the federal government to intervene.

1.2.3 Federal Policy Solutions

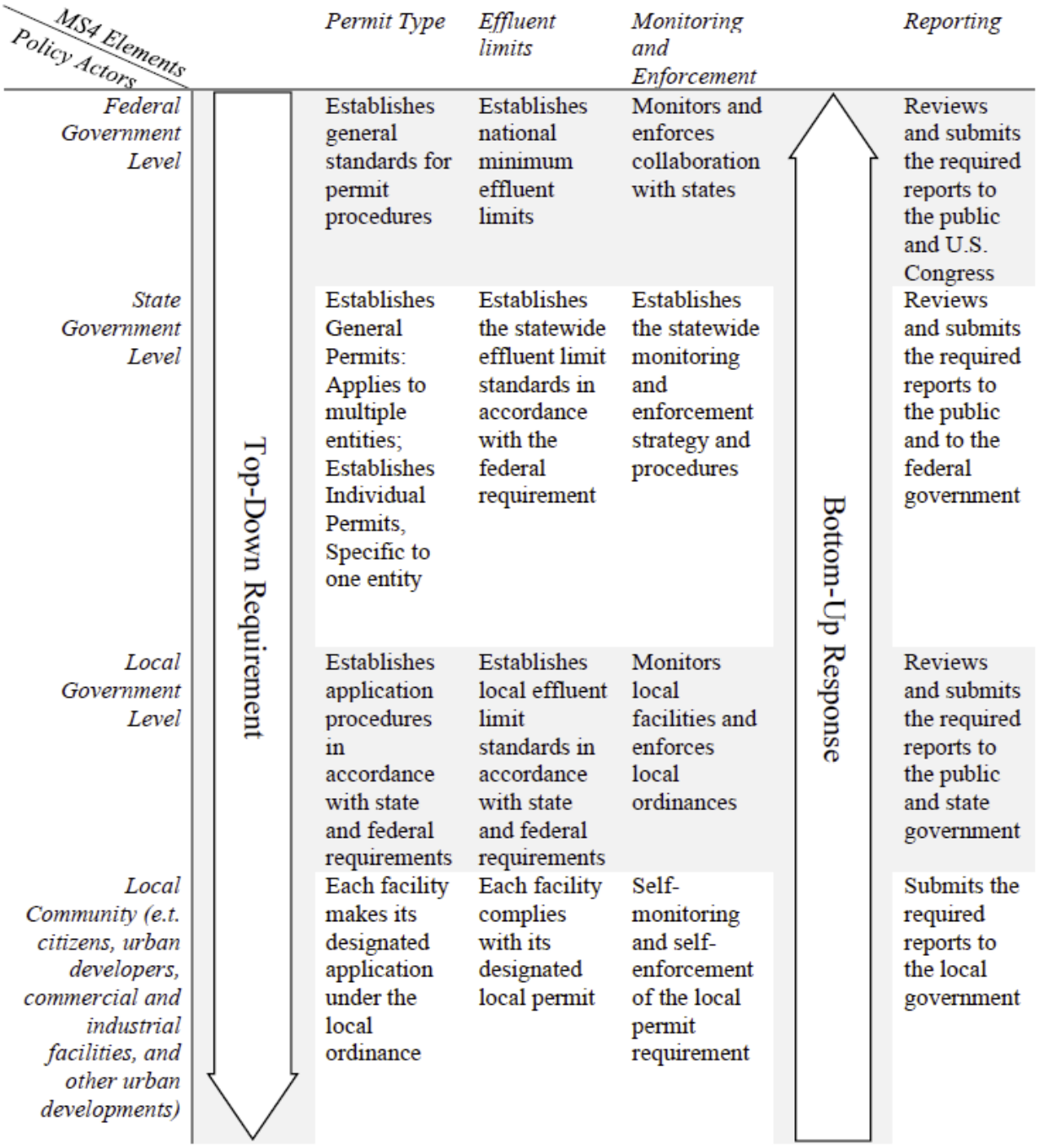
Legislation dealing with stormwater has been part of water legislation in general. The evolution of general water policy in the United States has gone through several historical phases (see Appendix A). According to Gerlak (2005), water policy has undergone a number of historical phases that have shaped the current features of water management. Essentially, water management rights were the provenance of state or local governments during the pre-New Deal period. However, the federal government increased its role in water management through a series of post-New Deal legislation through the mid-1980s. Since the mid-1980s, and especially since the passing of the 1987 Clean Water Act, there has been a decentralized process in implementing water policies.

Within this outline of the history of water policies, the Clean Water Act of 1972 was the first policy that addressed stormwater pollution at the national level. The Clean Water Act of 1972 aimed to reduce water pollution by reducing the discharge from pollution sources through a permission system (Gerlak, 2005). Moreover, the Clean Water Act of 1972 tasked the USEPA with developing National Pollutant Discharge Elimination System—NPDES permits (Adler, 2009a). NPDES permits involve two types of standards, namely, technology-based standards and

water quality-based limits. The technology-based standards are techniques determined by the EPA to be the best ways to deal with the source of pollution (Adler, 2009a). The water quality-based limits designate the amount of water needed to achieve water quality (Adler, 2009a). However, the Clean Water Act of 1972 did not identify sources of pollution or the identification of stormwater as a source of pollution that threatens water quality (Dolowitz, 2015). Therefore, the Clean Water Act of 1987 introduced amendments for stormwater management.

According to Copeland (2006), previous legislation had contributed to reducing pollution from industrial and municipal sources, but it gave little attention to the pollution caused by stormwater discharge from urban areas; thus, the Clean Water Act of 1987 added new requirements under Section 319 to control for stormwater discharge. Section 319 required the local government to establish best management practices (BMPs) in six areas under the minimum control measures (MCMs) to deal with stormwater discharge in accordance with NPDES permit requirements set by the USEPA. The MCMs included public education and outreach, public participation in the annual Stormwater Management Program (SWMP), illicit discharge detection and elimination of non-stormwater sources from their storm sewer system, management of construction site runoff, management of post-construction site runoff, and good housekeeping in municipal operations (USEPA National Menu of BMP, n.d.). Moreover, the amendments to the Clean Water Act of 1987 applied to all cities that operated separate storm sewer systems (MS4) (see Figure 1.1).

Figure 1.1: The MS4 Permit Structure

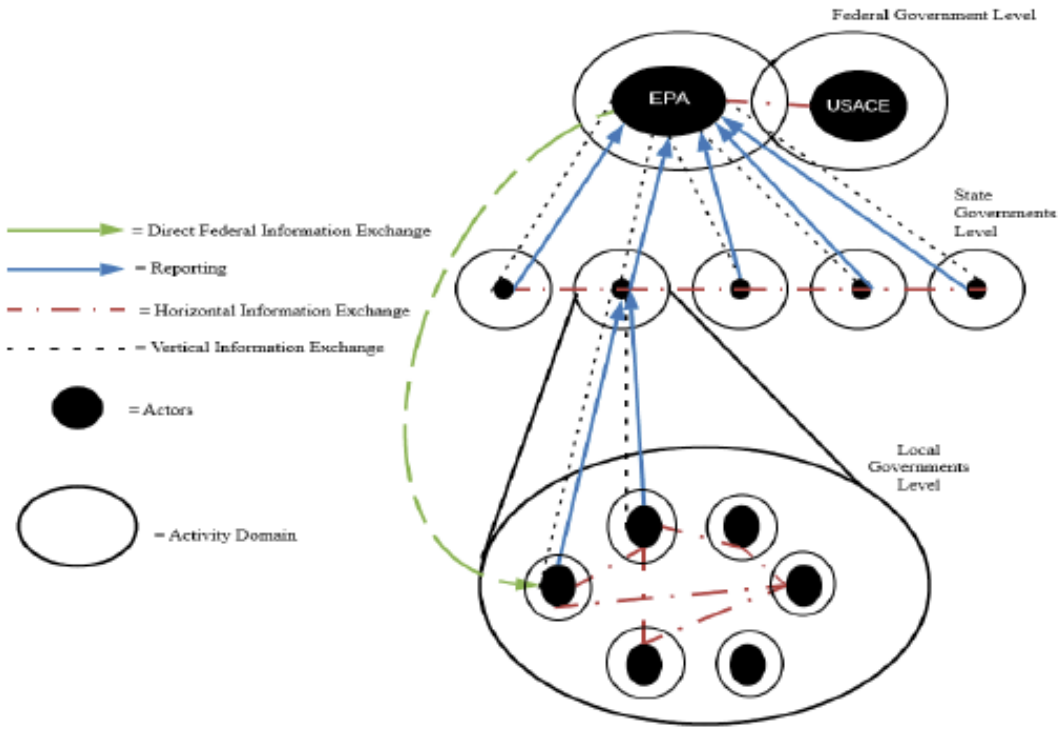


1.2.4 The Fragmentation of Implementing the MS4

According to the USEPA (2009), there were two phases in implementing new NPDES permits. Phase I began in 1990 and targeted all cities with a population of 100,000 or higher

based on 1990 U.S. Census Bureau estimates, and the total number of subjected entities exceeded 800 (USEPA, 2009). The implementation of Phase II began in 1998 and targeted all cities with a population under 100,000 from 1990 U.S. Census Bureau estimates (USEPA, 2009). NPDES permits regulated the 4% of U.S. land where 80% of the U.S. population lived (USEPA, 2009). In addition, the USEPA (2009) data indicate that approximately 7,000 permits were issued by both the EPA and the States to the subjected MS4 entities, including cities, counties, non-traditional local governments, public universities, and individual businesses. Although the legislation covered many US cities, the implementation of the project suffers from numerous problems.

Figure 1.2: Stormwater Management Fragmentation across Different Levels of Government



Although the legislation covers many US cities, the implementation of the project suffers from vertical and horizontal fragmentation. By looking at Figure 1.2, vertical fragmentation involves dividing the responsibility for implementing the program among the federal, state, and

local governments. The role of the federal government includes setting the policy requirement. In return, state governments choose the institutional framework for implementing policies. Each state is free to choose its own institutional approach (centralized or decentralized) for implementing stormwater management policies; thus, the implementation of stormwater policies becomes divided into several types of institutional frameworks that aim at meeting the requirements set by the federal government. In simple terms, implementing current stormwater management policies can be likened to a race that gives the contestants the freedom to choose the means and tools they desire to reach the desired goal. Depending on the institutional framework chosen by the state, local governments are obligated to fulfill the requirements imposed on them by higher authorities within the vertical fragmentation.

The horizontal fragmentation of implementing stormwater management policies is represented by the need for joint action between more than one organization in the implementation process at each level. For example, the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers need to work collectively to set the federal requirements. On the other hand, states need to work together because individual choices of a state can have an effect on the outcome of other verses. For example, if a state adopts a rapid drainage mechanism for stormwater, it may increase water flow in other states. On the contrary, if a state established a stormwater recycling program, water shares in the other states will decrease. The same dilemma of collective workers can be carried over to the decisions of local governments within a single state. Therefore, implementing current rainwater policies requires an understanding of the complexity associated with vertical and horizontal fragmentation.

1.3 The Need for a Multilevel Governance Framework to Understanding Fragmentation in the Implementation of Publica Policies

According to Organisation for Economic Co-operation and Development—OECD

(2010), the implementation of environmental policies is affected by the arrangement between the governments at different levels on the one hand and the cooperation between governments at the same level. In other words, to achieve effectiveness in implementing public policies, two questions must be discussed: How does the adopted institutional framework to deal with vertical fragmentation affect policy outcomes? And what motivates the local governments to work together to meet the legislative burden resulting from implementing the policies imposed on them by the higher governments? Several theories attempt to answer each of these questions, the most prominent of which is the local public economies and its polycentric approach vs. the race to the bottom theory on the vertical institutional fragmentation side and transaction costs on the horizontal institutional fragmentation side.

The theory of local public economies argued that regulating the environmental pollution must be done through a polycentric approach that includes the constitutional level where the rules are set to constitute the "collective choice" of the actors at lower levels, the collective choice level where the arrangements and decisions are made regarding implementing the constitutional choice, and the operational levels where the decisions are implemented in accordance with the arrangements and decisions that were made at the collective choice level (Cowie and Borrett, 2005). This approach argues for giving local governments more power in the implementation process, i.e., supporting decentralization in implementing public policies. On the other hand, the race to the bottom theory argument is that states will adopt relaxed environmental legislation to compete with other states in attracting economic development; thus, states will adopt more decentralization institutional to enforce national environmental policies, giving them an advantage in their competition with other states (Konisky, 2007). In other words, the conflict revolves around the effectiveness of concentrating the authority of policy implementation in the

hand of one government versus dividing the authority of policy implementation on several governments at different levels of government. Thus, the adopted institutional arrangement of implement public policies at the vertical level affects policy outcomes.

On the horizontal institutional fragmentation side, transaction cost theory is widely used by researchers to investigate the reasons why local governments cooperate (Andrew, 2009). During the nineties, there was great pressure coming for the New Public Management reforms on the government to reduce costs by producing services through external contracting (Milward & Editor, 1996). In light of this cost-cutting pressure, governments decisions regarding the internal production of the service or contracting it out (while preserving ownership and liability associated with the service) were linked to a number of transaction costs risks factors that include service-specific characteristics, the degree of competition, goal incongruence of the contracting parties (Brown & Potoski, 2003). In addition, the geographic location of the local government impacts their ability to have a sufficient number of suppliers—that is, the existence of a competitive market for the service (Morgan, Hirlinger, & England,1988; Morgan & Hirlinger, 1991). Therefore, it can be said that the decision on contractual relationships may be limited to whether the impact of the geographical location of the local government is positive or negative about joining contractual relations for the implementation of the service.

Therefore, understanding the issue of fragmentation in the implementation of stormwater management policies can be done by looking at the relationship between the level of centralization in the institutional framework adopted by the states to implement the policy and the policy outcomes, as well as by looking at the reasons that can affect the decision of local governments to enter into cooperative relationships to meet the legislative burdens resulting from the requirements of implementing stormwater management policies. Combing an understanding

of the impact of the institutional arrangements chosen by state governments to implement stormwater management policies at the vertical level with an understanding of the reasons why local governments enter into cooperative relationships at the horizontal level to meet the regulatory burdens imposed on them by federal/state governments presents a multilevel governance framework to understanding fragmentation in the implementation of stormwater policies since it studies the vertical links between local and state governments and its impact on water quality, as well as the relationship between local governments on the regional level.

1.4 Stormwater Quality at the State Level and Cooperation for Stormwater Regulatory Compliance

1.4.1 Stormwater Quality at the State Level

In light of the vertical fragmentation of implementing stormwater policies, Ringquist (1993) stated that "while we know a great deal about environmental politics at the federal level, we know very little about the politics behind state environmental policy. We know even less about the consequences that environmental regulations have had for environmental quality (i.e., the extent to which these efforts have succeeded in protecting the environment)" (p.xiii). In other words, there is a need to know the frameworks adopted by the states to implement public policies and know the impact of these institutional arrangements on the outcomes of politicians. Nevertheless, there are two main types of research literature related to the question of water quality and institutional arrangements. The first type is technical studies that rely on USEPA data from samples in the nine sectors where the regional agency offices are located; they include both engineering and environmental studies (Moore, Rodak, Ahmed, & Vogel, 2018; Comstock et al., 2012; National Research Council, 2008). This type of study omits the variation in the institutional arrangement between the states, which is reflected in the quality of the samples extracted from different locations. In other words, this research literature considers the

institutional structures for dealing with stormwater in the states to be a mystery box; thus, they should be omitted from the study. The second type of research literature on water quality in general and stormwater, in particular, discusses the role of states in the context of a specific case study (i.e., the study of only one state) (McDonald & Naughton, 2019; Aguilar & Dymond, 2016). This type of literature does not provide a complete picture of the impact of the types of institutional structures of the states on water quality and the reduction of stormwater pollution. Therefore, this dissertation contributes to bridging the gap on the impact of the institutional framework adopted by the states to implement environmental policy through empirically evaluating the role of the institutional arrangement (as represented in the States general MS4 permits) on the policy output (reducing the level of stormwater pollution). In addition, this paper focuses on the institutional arrangement used by states to implement stormwater management policies. Building on race to the bottom literature, the impact of the institutional arrangements centralization on the state water quality are examined. The paper uses a qualitative approach to compare and evaluate the variation in the state institutional arrangement in a sample of four case studies that include California, Texas, Virginia, and Minnesota.

1.4.2 Cooperation for Stormwater Regulatory Compliance

In light of the horizontal fragmentation of implementing stormwater policies, local governments found themselves burdened by the responsibility of implementing the stormwater management policies in two ways: bearing the cost of implementation and avoiding the negative externalities non-compliance by other local governments. As a result of not including regulatory burdens as one reason for entering into an interlocal agreement—ILA, the current ILA literature (Carr, Gerber, & Lupher, 2007; LeRoux & Carr, 2007; Wood, 2006) does not discuss the factors influencing the regulated local government's decision to join ILA. In addition, there is a

disagreement about the impact of cooperation and compliance with the regulative burdens within the environmental management literature (Youm, 2014; Hoornbeek, Beechey, & Pascarella, 2016). Therefore, this dissertation empirically examines factors affecting the regulated local government's decision to join ILA, which will expand interlocal cooperation and ILAs literature beyond public services provision/delivery to link it with regulatory burdens as a reason for joining an ILA. Building on the transaction costs framework, the paper examines the context of cooperation to comply with federal/state stormwater management policies. The paper uses a cross-sectional design to analyze a case study, and the unit of analysis is subjected cities. The case study consists of 119 cities subjected to the NPDES MS4 requirements in northern Texas during 2017.

1.5 Contributions to Theory and Practice

The multilevel governance framework to understanding fragmentation in the implementation of stormwater policies presented by this dissertation provides several contributes to theory and practice. On the theoretical side, the presented multilevel governance framework facilitates the understating of the linkage between the institutional arrangement at the state level and its impact on policy outcomes on the one hand. On the other hand, the proposed framework contributes to understanding the decision of local governments to enter into cooperative relationships to meet the legislative burdens imposed on them by the state and federal government. By understanding the impact of diversity in the institutional framework adopted by states to implement public policies on policy outcomes as well as the motives for entering into collaborative relationships at the regional level, researchers can better understand the relationship between vertical and horizontal fragmentation in the implementation of stormwater management policies.

Another contribution of this dissertation can be the use of qualitative and quantitative methods to investigate the questions posed. The qualitative methodology used to compare the case studies contributes to giving a more in-depth analysis of the institutional framework and contributes to responding to the need for a diversity of research methodologies in the field of public administration (Ospina, Esteve, & Lee, 2018). According to Ospina, Esteve, and Lee (2018), there are a limited number of studies in the field of public administration that use political documents as a source of qualitative data, let alone analyze them, which enhances the impact of this study on expanding the scope of research methodologies in the field of public administration. Therefore, future studies can use the current study methodology to apply it to another issue within the public administration's interest.

The other side of the contributions of this study lies in the fact that it gives attention to the issue of managing stormwater, which did receive limited attention from public administration literature. However, it is an issue that concerns the public administration as much as other disciplines. According to Dhakal and Chevalier (2016), specialized engineers mostly do stormwater management under a unified public work system or independent departments. The perception of the specialization of stormwater management influenced the way this issue was addressed in the literature on local cooperation. Such perception of the specialization of stormwater management leads ILA researchers to examine public works completely or not allocate any details about the stormwater management issue. Therefore, this study put the issue of managing stormwater upfront in the field of public administration.

Finally, the results of this dissertation will help public policymakers in the states to compare the performance of their institutional framework with other institutional frameworks; in turn, this will help improve their choices about dealing with stormwater or other environmental

policies. In addition, the results will assist professionals in exploring the institutional frameworks in which they work within their states, which should help them increase their performance and improve their job outcomes. Nevertheless, the results will assist local government officials in identifying the impact of geographical boundaries and other factors on the decision to join ILA and take advantage of cooperative relationships to meet the legislative burdens imposed on them by the state and federal government.

1.6 Organization of the Dissertation

Chapter 1 discusses the issue of vertical and horizontal fragmentation in the implementation of public policies and presents the research questions that this dissertation aims to answer. In addition, the importance of studying the issue of stormwater management and its policy solutions was discussed. Moreover, the chapter provides an overview of the polycentric approach and its relation with the proposed multilevel governance framework to understanding fragmentation in the implementation of stormwater policies. The chapter also provides an overview of the dissertation's contribution to theory and practice. Finally, this chapter concludes with an overview of the content of the chapters of this dissertation.

Chapter 2 illustrates the analytical framework adopted by this dissertation. The chapter starts by present the vertical fragmentation of stormwater management via discussing the relationship between the executive/legislative/judicial powers at the federal level, the relationship between the federal and state government, and the relationship between state and local governments. In addition, the chapter presented the relation between institutional arrangement centralization and vertical fragmentation. This chapter also discusses the competition and cooperation between local governments at the horizontal level. Moreover, it discusses the stormwater regulation burdens at the horizontal level. The chapter concludes by

offering an overview of the empirical implementation of the proposed framework for analysis.

Chapter 3 presents the first paper, a qualitative study focusing on the institutional arrangement used by states to implement stormwater management policies. This chapter presents literature on stormwater quality to answer the proposed research question. In addition, the chapter presents the proposed theoretical framework to explain the role of the institutional arrangement in the states on the issue of stormwater quality. The chapter then discusses the research methodology for investigating the research question and then follows a discussion and conclusion of the study results.

Chapter 4 presents the second paper, a quantitative study focusing on the local government's decision to join ILA to comply with federal/state stormwater management policies. This chapter presents literature on stormwater regulatory burdens compliance and ILA to answer the proposed research question. In addition, the chapter presents the proposed theoretical framework to explain the role of geographical location and population density on the decision of local governments to enter into cooperative relations to meet the legislative burdens associated with the implementation of stormwater policies. The chapter then discusses the research methodology for investigating the research question and then follows a discussion and conclusion of the study results.

Chapter 5 presents this dissertation conclusion. The chapter begins with an introduction about the goal of this dissertation and the steps it took to achieve the goal. In addition, the chapter discusses the most important results and their applications. The chapter also provides a summary of the most prominent contributions of this dissertation. The chapter concludes with a discussion of the limitation faced by the study, how they were overcome, and what the research literature could expand upon in the future.

CHAPTER 2

ANALYTICAL FRAMEWORK

As previously mentioned, this dissertation builds on the polycentric approach to provide a multilevel governance framework to understanding fragmentation in the implementation of stormwater policies that combined vertical and horizontal fragmentation. Investigating the implementation of stormwater policies between the various levels of government requires an understanding of the overall institutional framework that combines the three levels of government: federal, state, and local. In addition, it requires an understanding of the controversy surrounding the adoption of centralized or decentralized institutional arrangements in response to vertical fragmentation. On the other side, investigating the implementation of stormwater policies at the horizontal level requires an understanding of a mixture of competition and joint action between local governments.

To illustrate the analytical framework adopted by this dissertation, the next section presents the vertical fragmentation of stormwater management via discussing the relationship between the executive/legislative/judicial powers at the federal level, the relationship between the federal and state government, and the relationship between state and local governments. In addition, the relation between institutional arrangement centralization and vertical fragmentation is presented. This is followed by a discussion of competition and cooperation between local governments at the horizontal level. In addition, stormwater regulation burdens at the horizontal level is discussed. This concludes by offering an overview of the empirical implementation of the proposed framework for analysis.

2.1 Vertical Fragmentation of Stormwater Management

2.1.1 The Federal Level

As mentioned previously, the federal government eventually intervened in managing the water pollution issue by passing the Clean Water Act of 1972. However, stormwater management was absent from federal legislation until the passing of the MS4 permit amendments under the Clean Water Act of 1987. Congress has adopted a centralized but flexible policy in creating permit requirements (Copeland, 2006; Adler, 2009a). From the central perspective, the US Congress granted a number of exclusive powers to the USEPA to set standards that represent the minimum limits that must be adhered to by states to achieve the policy goals (aiming to reduce the level of water pollution caused by stormwater). According to the USEPA (n.d.), the Clean Water Act gave the agency the following authority:

1- Section 301(a) prohibits the discharge of any pollutants into navigable waters except in compliance with the CWA (typically implemented in an NPDES permit issued under Section 402).

2- Section 304(h) requires the EPA to establish test procedures to measure pollutants in Clean Water Act programs, such as the NPDES.

3- Section 501(a) authorizes the EPA to prescribe the regulations necessary to carry out functions under the Act.

Besides the authority to set standards, the US Congress also gave the USEPA a number of enforcement-related authorities, such as the authority to issue permits or delegate the authority to issue permits to states. Finally, the US Congress gave the USEPA and the US Army Corps of Engineers the authority to monitor the national water quality.

Although the Supreme Court granted the federal government water proprietary rights (Arizona vs. California, 1963), the complete centralization of stormwater policies would be faced by a lack of cooperation from both state and local levels of governments. Two main elements that may have motivated the non-cooperation from both state and local governments in achieving policy goals were the already-existing solutions and the economic impact of policies. First, there were disparities related to the historical background of dealing with the problem of stormwater

between states, which could create a coordination problem between the national solutions and the solutions applied at the other levels. For example, states such as California have legislation that authorizes stormwater management. Indeed, there are norms used to govern stormwater management in most states; thus, the U.S. Congress needed a way to integrate the existing solutions to the stormwater problem with the national solutions. The other factor is the economic impacts, as implementing legislative solutions passed by the U.S. Congress might increase the cost to taxpayers and businesses that must meet the requirements of the legislation. As previously mentioned, most states have refrained from adopting legislative solutions to stormwater for fear of economic costs. Therefore, the U.S. Congress has combined the centralized policy with certain flexibility measures to motivate the other levels of government to cooperate in implementing the national solution. The flexibility measures taken by the U.S. Congress to address the possibility of a lack of cooperation and coordination include giving the USEPA authority to delegate the permitting process to the states and providing some federal financial support to the states to meet the requirements of the legislation. According to the USEPA (n.d.), the agency has the right to negotiate, delegate, or withdraw the authorization of licenses from the states. As of 2015, 47 states had obtained either full or partial authority over the process of issuing permits related to addressing the issue of stormwater (USEPA, n.d.).

2.1.2 Federal-State Fragmentation

Questions of primacy or authority in implementing environmental programs have opened a new era in the relationship between the federal and state governments. Not all states have achieved primacy in this relationship, and the acquisition has not taken place simultaneously. On the contrary, a few states acquired this authority during the 1990s, and some states, such as Alaska, achieved primacy as late as 2008. The difference in the states' acquisition of authority

over the implementation of environmental programs has attracted the interest of researchers in this domain. For example, Crotty (1987) was one of the first researchers to study the phenomenon of states' voluntary acquisition of environmental programs. In examining the rate of adoption of the program by the states, Crotty (1987) found that a close relationship between the USEPA regional offices and the states and the existence of a previous attitude toward the environment on the part of state governments have a positive effect on the adoption rate. Nevertheless, Crotty (1987) found that some regional offices (such as USEPA regional offices IV and VI) have played a role in easing states' requirements to compel them to take over responsibility for implementing the regulations. Similarly, Hays, Esler, and Hays (1996) found that the strength of a state's commitment to implement the environmental policies that they undertook to implement varied according to the political characteristics of the state, such as the direction of public opinion regarding the environment and the professionalism of legislators in the state.

Furthermore, Chang, Sigman, and Traub (2014) argued that states with pro-environmental outlooks aim to strengthen measures by acquiring regulatory enforcement authority. In contrast, some researchers have argued that the reasons states take over the power to implement water protection legislation lie in their desire to reduce enforcement effectiveness (Woods, 2005; Sigman, 2005). According to this literature, states rely on measures taken by neighboring states to ensure water quality (free-riding) or reduce the quality of enforcement and monitoring to maintain/attract economic development. In addition, some researchers have argued that the permit system itself is ineffective and creates problems of delay in administrative procedures, which hinder the process of economic development (Ulibarri, Cain, & Ajami, 2017). Therefore, the literature is still far from settling on why states seek to acquire the authority to

implement water quality regulations.

2.1.3 State-Local Fragmentation

As stated, Section 319 of the CWA of 1987 requires the local government to adopt best management practices (BMPs) in six areas under the minimum control measures (MCMs) to deal with stormwater discharge in accordance with NPDES permit requirements set by the USEPA. Thus, local governments are the units targeted for the implementation of national solutions to the stormwater problem. However, being given the primacy or authority over implementing environmental programs, states have become responsible for achieving program objectives (Crotty, 1987). In other words, any state that has acquired a stormwater permit authority has become responsible for reducing stormwater pollution and maintaining the quality of surface water within its geographical limits. According to Copeland (2006), the Clean Water Act of 1987 did not provide a comprehensive breakdown of the process of managing the application of the permit as it did regarding industrial sources of pollution. Therefore, each of the 47 states that have the authority to issue permits has its own institutional framework for program implementation, which is reflected in the differences seen in their ability to achieve the objectives of the legislation.

2.1.4 Institutional Arrangement Centralization and Vertical Fragmentation

Concerning the implementation of public policies in light of the vertical fragmentation at the level of intergovernmental relations, Lyons and Lowery (1989) stated that there are two views on dealing with this fragmentation. The first viewpoint to the need for centralization of authority to enhance the efficiency and effectiveness of policy implementation by reducing the number of actors or units associated with an implementation process (Lyons and Lowery, 1989). According to Lyons and Lowery (1989), this approach defines centralization as the consolidation

of authority in a single governmental body that produces and delivers service; thus, policies become more focused, ensuring a uniform response to public policy problems. For example, a single government or government agency is given the authority to solve a problem. It is empowered to impose its policy solution on all the bodies under its authority regardless of their input, context, abilities... et. The second point of view stems from local public economies (please see section 2.2.1. for more detail about the assumptions of this view), which argues for the importance of decentralization to provide opportunities for citizens to choose the basket of services that suits their orientations and individual needs (Lyons and Lowery, 1989). According to Lyons and Lowery (1989), this approach defines decentralization as reallocating the authority of the central authorities to the nearest government unit to the citizen, which will contribute to meeting the needs of their citizens within their jurisdiction boundaries. In other words, the government or the governmental body that provides the service directly to the citizen should wield the greatest amount of power. For example, the power of the city must be greater than that of the state or the federal government. Such conceptualization of authority decentralization aims at making local government more responsive toward the problems within their domain. On the other hand, the concept of centralization aims to overcome the problem of coordination and free-ride problems that may occur as a result of multiple responses to the same public policy issues.

The degree of centralization in the institutional frameworks pursued by the states is linked to the concept of competition. The race to the bottom theory argues that states will adopt relaxed environmental legislation to compete with other states in attracting economic development; thus, states will adopt greater institutional decentralization to enforce national environmental policies, which will give them an advantage in their competition with other states (Konisky, 2007). In other words, the states will give a high degree of discretion to local

governments to meet the legal requirements associated with federal environmental legislation to attract economic development. Therefore, the policy outcome in the state can be affected by the institutional arrangement that the state chooses to implement the policies.

On stormwater management, we find a variation in the degrees of centralization among the states. In light of the lack of regulation of how the states administer the permits, local governments are obligated to operate within the institutional frameworks established by the states to administer legislation related to stormwater. According to Adler (2009a), the institutional arrangement adopted by states to manage stormwater legislation can be categorized by geographical location or the degree of institutional centralization. For example, the eastern states entrust managing stormwater management legislation to a single agency such as a statewide environmental agency. In contrast, the western U.S. states task the managing of stormwater legislation to more than one agency or level; this is the case with the state of California. Another area in which the differences in institutional frameworks between states can be seen is the degree of centralization. For example, in Texas, local governments have greater discretion in setting the effluent limits (Storm Water Cooperative Agreement Handbook, 2009). In contrast, we find that local governments in California do not have much discretion in setting effluent limits (Water Education Foundation, 2013). In general, the institutional framework that states adopt in implementing stormwater policies affects the outcomes of these policies.

2.2 Horizontal Fragmentation of Stormwater Management

2.2.1 Local Government Competition

The relationships of local governments with each other can be a mixture of competition and joint action. Local governments in the United States are characterized by fragmentation. In other words, each local unit has independent authority over its geographical boundaries. In

addition, each local unit is responsible for providing services to citizens and has the authority to impose a property tax. Thus, Tiebout (1956) explains that local governments can be seen as firms competing in a quasi-market providing public services to residents. According to Tiebout (1956), there are two reasons why local governments should compete. The first reason is people are seeking allocative efficiency—people get what they want, given what they want to pay. For example, if I pay a certain amount of property tax, I expect to receive a certain service quality. Therefore, people will sort themselves across local units to find the unit that approximates their preferences for the public good. The second reason relates to the possibility for competition to raise the efficiency of local units as a result of a competition to attract population, a process thought to work like the invisible hand in the market. In other words, the competition will create a diversity of choices for the consumer and will increase pressure on local units to find effective alternatives to compete in this market. This insight, in turn, leads to a discussion about how competition between local governments has occurred. According to Ostrom, Tiebout, and Warren (1961), local units compete by providing services commensurate with the taxes they impose. In other words, local units compete by providing a basket of services that targets residents' preferences in order to attract them. In addition, the availability to access information about other local units will increase pressure to offer a level of service similar to that offered by other local units.

This competitive public service economy view is built on a number of assumptions, including that "individuals are costlessly mobile and have heterogeneous preferences; individuals know tax and services of all local units; there are a large number of local units; employment does not affect individual residential choice; there are no inter-jurisdictional externalities; every jurisdiction has a (known) optimal size where the average cost of services provided is

minimized; jurisdictions below their optimal size seek to attract new residents" (Millimet, 2014, p. 1673). To put this in perspective, the process of people moving from one place to another is, in fact, costly; consequently, the inability to afford the cost of moving is one of the reasons for not moving or for seeking an alternative. Similarly, individuals cannot be aware of all the available options as they sort their options according to their preferences. Similarly, local units cannot know all individual options or always arrange services in accordance with their preferences. Importantly, a single decision from a local unit can have negative externalities for other units. For example, building a shopping center in city A can cause traffic congestion in city B. Therefore, Brennan and Buchanun (1980) argued that the only thing that local units can compete with is the property tax prices and that all other services are equal in their impact on the residents' decision (as cited in Oates, 1985). In other words, local units can compete not by providing a basket of services but rather by reducing property taxes.

Regardless, local unit competition can lead to a wider range of positive and negative outcomes. Among the positive ones, competition creates a multiplicity of options for citizens, which is consistent with democratic principles. On the other hand, competition via lowering tax rates will decrease the quality of services provided by government units. The reason is that the local unit will tend to reduce spending on services to make up for the shortfall in tax revenue when spending is reduced (Miller & Cox, 2015). Further, service competition will reduce the efficiency (cost per unit) of services at the regional level since there will be a duplication of services across jurisdictions. One of the most important consequences of competition between local governments is the creation of collective action problems at the horizontal level. According to Feiock (2013), one government's decision regarding a specific function can affect other governments' functions. In other words, local governments do not operate in an independent

world such that their decisions do not impact other government units; instead, any decision by a local government will impact other governments. In addition, local governments' pursuit of individual gains without finding a way to integrate decisions with other local governments will result in a collectively inefficient outcome (Feiock, 2013). Therefore, local governments often find themselves in need of working collectively to reduce the negative externalities that may spill over across jurisdiction boundaries.

2.2.2 Local Government Collaboration

The notion of local government collective work has received a number of definitions in the research literature (see Table 2.1). By tracing the components of these definitions, one can observe a set of common elements among them. The first element in common among the definitions is "process," which means collaboration in performing a series of operations on something to change or maintain it. The second element of the definition is "multi-organizational," which indicates that collaboration includes a relationship that brings together a number of actors. The third common element is "solving," which indicates that the goal of the collaboration process is to solve some problem. The last common element among the definitions is "not single," which indicates that the problem in question cannot be solved by a single actor independently of the rest of the actors. Thus, all these definitions suggest the same meaning: collaboration is an operation conducted by multiple actors to solve a problem that is unsolvable by a single independent actor.

Table 2.1: Definitions of Collaboration

Author(s)	Definition
O'Leary, Gazley, McGuire, and Bingham (2009)	"Collaborative public management is a concept that describes the process of facilitating and operating in multi-organizational arrangements to solve problems that cannot be solved or easily solved by single organizations. Collaborative means to co-labor, to achieve common goals, often working across boundaries and in multi-sector and multi-actor relationships. Collaboration is based on the value of

Author(s)	Definition
	reciprocity. Collaborative public management may include participatory governance: the active involvement of citizens in government decision-making" (p.3).
McGuire (2006)	"Collaborative public management is a concept that describes the process of facilitating and operating in multiorganizational arrangements in order to remedy problems that cannot be solved — or solved easily — by single organizations" (p. 33).
Gray (1989, as cited in Guo and Acar, 2005, p. 342).	Collaboration is a "process through which parties who see different aspects of a problem can constructively explore their differences and search for solutions that go beyond their own limited visions of what is possible" (p. 5).
Sink (1998, as cited in Gazley 2008)	A "process by which organizations with a stake in a problem seek a mutually determined solution [by pursuing] objectives they could not achieve working alone" (p. 118).

Nevertheless, the definitions point to the complexity of the concept of collaboration in several ways. First, the definitions do not specify the types of operations included within the scope of collaboration. Second, the definitions do not specify the actors that we can consider to be part of the collaboration process. Similarly, these definitions do not define the time frame in which the collaboration processes begin, endure, or end, suggesting that collaboration might be eternal. Finally, these definitions indicate that the problem of concern must be unsolvable by individuals; this, in turn, raises the question of the degree of vulnerability to or influence by the problem for the actors involved in the collaboration process.

One of the explanations given for the motives of local governments for collaboration comes from resource dependency theory (Pfeffer & Salancik, 1978; Guo & Acar, 2005; O'Leary et al., 2009). This perspective argues that the decision for an organization to enter into a collaborative relationship stems from its strategic decisions regarding its resources. These decisions are occasioned by the fact that there is a mutual need among organizations to exchange resources for continuity and survival. In addition, cooperation in this regard may aim to increase certain resources or reduce competition. The second type of explanation for collaboration

relationships stems from exchange theories. From the transaction cost theory perspective, the pressure that local units face to reduce costs and increase performance quality makes them look for alternatives to achieve this; thus, they enter into collaborative relationships for mutual gain (O'Leary et al., 2009).

Nevertheless, the primary goal of the collaboration relationship from the transaction cost perspective is to minimize an organization's transaction cost (the cost of negotiation, information, monitoring, etc.) (Guo & Acar, 2005). Another interpretation of collaborative relationships depends on the institutional framework of which the actor is a part. According to Guo and Acar (2005), actors need to demonstrate conformity to the norms and social expectations of the institutional environment; thus, they establish linkages or exchanges with other actors to meet the necessary requirements. There are two kinds of effects of the institutional framework on the actors' decision to collaborate: those arising from social and from industry norms. At the social level, actors need to demonstrate their trustworthiness to other actors to receive a joint grant. At the industry level, industry institutional norms may push members to enter into collaborative relationships assuming that the sense of responsibility toward professional norms will lead managers to seek to form collaborative relationships with their peers in the same profession (O'Leary et al., 2009). Finally, the collaboration between local governments takes a number of forms, which have received a range of characterization and use description in the literature. O'Leary et al. (2009) indicate there is no specific way to link a collaboration form to a specific theoretical explanation of collaboration. For example, contracting between local governments may be considered a privatization tool (O'Leary et al., 2009), a formal collaboration tool (Guo & Acar, 2005), or a cooperation tool as in Feiock's (2013) institutional collective action framework (ICA).

2.2.3 The Role of Federal and State Governments at Horizontal Level

Yi, Suo, Shen, Zhang, Ramaswami, and Feiock (2018) argued that federal and state governments, directly and indirectly, influence cooperation between local units. The direct impact by the federal government occurs through the attachment of cooperation requirements between local units to obtain federal funding. The direct impact on state governments occurs through the enactment of legislation requiring local governments to act collectively or develop collective action. One of the best-known examples of direct intervention by the state government in cooperative relations between government units can be found in Iowa, which established an institutional framework for registering contracts between local units; thus, the state contributed to reducing the risks associated with enforcing contracts, which reduced opportunistic behaviors in carrying out the contracts (Thurmaier, 2005). Federal and state governments indirectly affect cooperative relationships between local units through support for professional meetings and specialized conferences. According to Yi et al. (2018), the Federal Environmental Protection Agency regularly holds seminars and courses between local unit managers; this enhances the formation of professional networks, contributing to the forming of a collaboration between local units.

2.2.4 Burdens of Stormwater Regulation at the Horizontal Level

With the delegation of the stormwater management program implementation responsibility from the federal government to states and from the states to local governments, local governments have found themselves burdened by this responsibility in two ways: bearing the cost of implementation and avoiding the negative externalities of non-compliance by other local governments. According to Copeland (2006), deficient funding is a major challenge in implementing NPDES permits since the 1987 law did not specify adequate funding for

implementation. Despite the USAPA estimates that in 1994 the annual cost of permit compliance was between "$750 million and $1.1 billion a year," there are no precise estimates of the cost in the report data (2006). Moreover, the Clean Watersheds Needs Survey indicated that stormwater management programs in the states cost approximately twenty billion dollars (USEPA, 2016). For example, the state of Texas alone has stated that it needed $3 billion to manage stormwater in the state (USEPA, 2016). Thus, the current solutions represent a legislative burden for local governments subjected to stormwater permits (MS4 permits). Local governments subject to the MS4 stormwater permits regulations must secure funds to comply with the MS4 requirements. On the other hand, the EPA and its counterparts in the states devote resources to ensuring compliance and violation fines, as occurs in Texas (TCEQ, 2013).

The other burden involved in implementing current solutions (involving MS4 permits) is the negative externalities of non-compliance. First, compliance with the MS4 regulation requires cooperation between the subjected local governments, given the fact that a drainage system could go through multiple cities. According to Minan (2005), the MS4 faces a legal liability dilemma because it requires a complete drainage system that goes from the stormwater collection point to a discharge point; thus, the discharge may go through multiple cities, which raises concerns about who is liable for the pollution as well as about the economic cost associated with implementing the MS4 requirements. Besides the problem of liability, failure to comply with the existing laws leads to the emergence of a stormwater collective action problem for all the actors in the region. This, in turn, may lead to flooding or to the transfer of harmful waste from the source to the neighboring governments.

Both the USEPA and the states have recognized the importance of cooperation between local units to achieve the goals of stormwater management programs. For example, the USEPA

allows joint permits to be issued for a number of local governments. This type of permit includes a comprehensive plan for all members participating in the permit. At the state level, we find that some permits assign coordination between local governments to regional organizations. For example, in California, regional organizations are relied on to enforce stormwater permit requirements. On the other hand, other regional actors (such as the North Central Texas Council of Governments) urge local governments to cooperate to meet legislative requirements (Storm Water Cooperative Agreement Handbook, 2009).

2.3 A Multilevel Governance Framework to Understanding Fragmentation in the Implementation of Stormwater Policies

As previously mentioned, institutional arrangements at the vertical level affect the policy outcomes on the one hand; On the other hand, the factors that lead to cooperation between local governments at the horizontal level must be considered to ensure access to the policy outcomes. More specifically, national or state governments cannot effectively implement policies without framing their relationship with local governments who act as agents of policy enforcement on the ground (OECD, 2010). On the other hand, local governments cannot effectively implement the policies imposed on them independently of other governments at the horizontal level (OECD, 2010). Thus, there is always a need for a multilevel governance framework to understand the extent of the effectiveness of the institutional framework followed by the higher government within the vertical level in achieving public policy objectives on the one hand, and on the other hand, knowing the reasons that motivate local governments to cooperate at the horizontal level. In other words, to achieve effectiveness in implementing public policies, two questions must be discussed: How does the adopted institutional framework to deal with vertical fragmentation affect policy outcomes? And what motivates the local governments to work together to meet the legislative burden resulting from implementing the policies imposed on them by the higher

governments?

Some theories attempt to answer each of these questions, the most prominent of which is the local public economies and its polycentric approach vs. the race to the bottom theory on the vertical institutional fragmentation side and transaction costs on the horizontal institutional fragmentation side. The theory of local public economies argued that regulating environmental pollution must be done through a polycentric approach (Cowie and Borrett, 2005). The polycentric approach is widely used to explain the vertical institutional fragmentation of implementing environmental policies (Zelli, 2015; Homsy, Liu, & Warner, 2019). The polycentric approach is employed in the theory of local public economies, developed by Elinor Ostrom to categorize the institutional actions that aim to deal with the collective action problems into three levels (Cowie & Borrett, 2005). According to Cowie & Borrett (2005), the top (constitutional) level rules are set to constitute the "collective choice" of the actors at lower levels. At the intermediate (collective choice) level, the arrangements and decisions are made according to the rules established at the constitutional level. At lower (operational) levels, the decisions are implemented according to the arrangements and decisions made at the collective choice level. To put this into the environmental policies, both the Federal Environmental Protection Agency and its corresponding agencies in the states develop environmental legislation to face collective environmental problems, which can be seen as existing at the constitutional level. Consequently, local governments need to provide the appropriate framework to meet this legislation, corresponding to the collective choice level. In addition, the relevant departments of local governments implement these environmental decisions, which represent the operational levels. Although the polycentric approach contributes to understanding institutional fragmentation at the vertical level, the relationship between local governments at the horizontal

level must be considered to achieve the desired policy goals.

The polycentric approach argues for giving local governments more power in the implementation process, i.e., supporting decentralization in implementing public policies. On the other hand, the race to the bottom theory argument is that states will adopt relaxed environmental legislation to compete with other states in attracting economic development; thus, states will adopt more decentralization institutional to enforce national environmental policies, giving them an advantage in their competition with other states (Konisky, 2007). In other words, the states will give a high degree of discretion to local governments to meet the legal requirements associated with federal environmental legislation to attract economic development. Therefore, at the vertical institutional fragmentation, there is a conflict between the impact of centralization and decentralization on the outcomes of public policies. In other words, the conflict revolves around the effectiveness of concentrating the authority of policy implementation in the hand of one government versus dividing the authority of policy implementation on several governments at different levels of government. The adopted institutional arrangement of implement public policies at the vertical level affects policy outcomes.

The horizontal institutional fragmentation side, transaction costs theory, is widely used by researchers to investigate why local governments cooperate (Andrew, 2009). In this respect, arrangements made by states to deal with the uncertainty problems associated with solving collective action problems impose costs on local governments, which in turn will seek to into contractual relationships for compliance that minimize the transaction costs of contracting (Andrew, 2009). During the nineties, there was great pressure coming for the New Public Management reforms on the government to reduce costs by producing services through external contracting (Milward & Editor, 1996). In light of this cost-cutting pressure, governments

decisions regarding the internal production of the service or contracting it out (while preserving ownership and liability associated with the service) were linked to a number of transaction costs risks factors that include service-specific characteristics, the degree of competition, goal incongruence of the contracting parties (Brown & Potoski, 2003). The degree of competition between the service vendors represents an important transaction costs risk factor. According to Brown and Potoski (2003), the contracting process becomes more efficient if there are a sufficient number of competing service providers because the sufficient number of competitors contributes to revealing information about the real price of the service in addition to reducing the cost of monitoring, as the service providers will be under threat of losing the contract in favor of other providers in the next contracting round if they do not adhere to the quality of implementation. According to Morgan, Hirlinger, and England (1988) and Morgan and Hirlinger (1991), the geographic location of the local government impact their ability to have a sufficient number of suppliers—that is, the existence of a competitive market for the service; thus, the location of local governments within Standard Metropolitan Area increases the opportunities for contracting out to provide stormwater management service. On the other side, LeRoux and Carr (2007) found that the increase in the number of neighbors negatively affects the decision to join the interlocal agreement, which contradicts the assumption regarding the impact of the degree of competition on transaction costs. Therefore, it can be said that the decision on contractual relationships may be limited to whether the impact of the geographical location of the local government is positive or negative about joining contractual relations for the implementation of the service.

As explained in the previous section, implementing the current policy solutions (MS4 permit) to stormwater issues require joint action of governments at different levels (federal, state,

local governments) and between units at the same level (federal-federal, state-state, local government-local government). In addition, understanding the issue of fragmentation in the implementation of stormwater management policies can be done by looking at the relationship between the level of centralization in the institutional framework adopted by the states to implement the policy and the policy outcomes, as well as by looking at the reasons that can affect the decision of local governments to enter into cooperative relationships to meet the legislative burdens resulting from the requirements of implementing stormwater management policies. On the one hand, the two solutions available to deal with vertical fragmentation in implementing public policies are either adopting centralized or decentralized institutional arrangements (Lyons and Lowery, 1989). Accordingly, the impact of choosing any of these institutional arrangements on public policy outcomes must be recognized. On the other hand, local governments that suffer from meeting the regulatory burdens imposed on them by the federal and state governments need to work jointly to reduce the cost of compliance first and then reduce the negative effects of not like other governments. Combing an understanding of the impact of the institutional arrangements chosen by state governments to implement stormwater management policies at the vertical level with an understanding of the reasons why local governments enter into cooperative relationships at the horizontal level to meet the regulatory burdens imposed on them by federal/state governments presents a multilevel governance framework to understanding fragmentation in the implementation of stormwater policies since it studies the vertical links between local and state governments and its impact on water quality, as well as the relationship between local governments on the regional level. This dissertation seeks to empirically test the proposed framework via carrying out two empirical studies.

The first paper focuses on the institutional arrangement used by states to implement

stormwater management policies. The NPDES gives the states the freedom to adopt the institutional arrangement if the states choose to hold the authority over the program; otherwise, the USAPA will adopt the institutional arrangement for implementing the program. Building on race to the bottom literature, the impact of the institutional arrangements centralization on the state water quality is examined. The paper uses a qualitative approach to compare and evaluate the variation in the state institutional arrangement in a sample of four case studies that include California, Texas, Virginia, and Minnesota. This study analyzes the state stormwater institutional arrangement on five dimensions: formalism, coercion, education, prioritization, and accommodation. Since stormwater quality is changeable over time, the study uses five years (2013-2018) permitting cycle to assess the stormwater quality status in sample case studies based on reports issued by these states during the permit period.

The second paper focuses on the local government's decision to join ILA to comply with federal/state stormwater management policies. Although regional cooperation is not part of the stormwater regulations, the USAPA encourages regional cooperation, and some states incorporated it into their institutional arrangement. Building on the Transaction costs framework, the paper examines the context of cooperation to comply with federal/state stormwater management policies. The paper uses a cross-sectional design to analyze a case study, and the unit of analysis is subjected cities. The case study consists of 119 cities subjected to the NPDES MS4 requirements in northern Texas during 2017. The dependent variable in this paper is the membership of the regional ILA, and the independent variables are the number of neighboring cities and population density. Community wealth, public works spending, stormwater fee, government type, and the percent of the population over 65 is used as control variables. Logistic regression is used for data analysis.

CHAPTER 3

ESSAY 1: STORMWATER QUALITY AT THE STATE LEVEL

3.1 Introduction

Public policy implementation fragmentation at the vertical level is manifested through the transfer of powers of implementation between different levels of government. In addition, the process of delegating authority to implement public policy, especially environmental policy, has received attention from researchers as it constitutes an aspect of a new era in inter-governmental relations. The devolution of responsibility for environmental policies from one tier of government to another has led researchers to investigate the potential of this process to affect public policy performance and its ability to promote the achievement of those policy goals. According to Cutter and DeShazo (2007), the phase of devolution of authority to implement environmental policies begins by delegating the authority from the federal government to the fifty state governments; the states, in turn, transfer this authority to another series of institutional arrangements within in its activity domain before the implementation process ends to a local authority that implements its environmental policy within its local activity domain or jurisdiction. The devolution of environmental policies creates a movement known as the "race to the bottom," and the related theory argues that states will adopt relaxed environmental legislation to compete with other states in attracting economic development (Konisky, 2007). In other words, the states will give a high degree of discretion to local governments to meet the legal requirements associated with federal environmental legislation to attract economic development.

In the area of water policies, we find a discrepancy in the institutional frameworks that states choose to implement federal water policies. The diversity between institutional frameworks adopted by states to implement water policies extends over a spectrum of

centralization to decentralized that can be explained by each state's self-policy goals, which may include increasing/decreasing the policy requirements or free-riding on the efforts of other states (Chang, Sigman, & Traub, 2014; Woods, 2005; Sigman, 2005). Therefore, this paper aims to investigate the impact of the states' institutional arrangements on environmental policy outputs by focusing on the issue of stormwater. Specifically, this paper investigates the effects of variations in the institutional arrangements that states have adapted to implement federal policies to reduce water pollution from stormwater. The paper seeks an answer to the following question:

> *How do the institutional arrangements adopted to implement stormwater policies influence variation in stormwater quality at the state level?*

The NPDES gives the states the freedom to adopt institutional arrangements if the states choose to hold authority over the program; otherwise, the USAPA will determine the institutional arrangements for implementing the program. However, the stormwater literature has largely overlooked the importance of the impact of the types of state institutional structures on stormwater quality and the reduction of stormwater pollution. Such literature has been either technical studies based on engineering and environmental work that has omitted the variation in the institutional arrangements among states or studies focusing on the role of states based on specific case studies with the absence of a holistic depiction of the impact of institutional frameworks on the problem. Therefore, this paper contributes to bridging the gap in our understanding of the impact of the institutional frameworks adopted by the states to implement environmental policy through empirically evaluating the role of the institutional arrangements (as represented in the States general MS4 permits) on the policy output (i.e., reducing the level of stormwater pollution). In addition, the paper provides a full picture of the impact of the institutional framework in the states on policy outputs by including four case studies: California, Texas, Virginia, and Minnesota. This study also enables public policymakers in the states to

compare the performance of their institutional frameworks with other institutional frameworks; in turn, this will help them to improve their choices about dealing with stormwater or other environmental issues. Finally, the paper results assist professionals in exploring the institutional frameworks in which they work within their states, which should help them increase their performance and improve their work outcomes.

The literature on stormwater quality relevant to the proposed research question is discussed in the next section. In addition, the paper presents the proposed theoretical framework to explain the role of the institutional arrangements in the states for the issue of stormwater quality. The paper then discusses the research methodology for investigating the research question; this is followed by a discussion and conclusion on the study results.

3.2 Literature Review

There are two trends in the literature on the consequences of states' assuming environmental program enforcement authority, particularly in the area of stormwater management policies. The first trend is the technical studies, which are primarily in the engineering and environmental disciplines. According to Moore, Rodak, Ahmed, and Vogel (2018), "Over 50 papers were published in 2017 regarding the physical, chemical and biological characteristics of stormwater and how these characteristics are influenced by land use and other environmental factors" (p. 1822). In other words, most of the literature on stormwater published during the year under review revolved around the technical (biological and physical) characteristics associated with stormwater management. Although technical studies aimed at improving the performance measures included plans for best management practices (BMPs—the required component of the MS4 permits for local governments), they have contributed to the complexity of these plans because the techniques used to manage stormwater are constantly

changing (Comstock et al., 2012). Nevertheless, the UNEPA carried out two main projects to measure rainwater quality. The first effort, the National Urban Runoff Program (NURP), was concluded in 1983; it aimed to measure the quality of stormwater based on the level of seven types of pollutants: the "total suspended solids (TSS), 5-day biological oxygen demand (BOD5), chemical oxygen demand (COD), total phosphorus (TP), total Kjeldahl nitrogen (TKN), nitrite plus nitrate (NO2+NO3), total copper (Cu), total lead (Pb), and total zinc (Zn)" (National Research Council, 2008, p. 215).

Similarly, the National Stormwater Quality Database (NPDES), begun in 2003, collects information about MS4 permit holders annually with regard to the quality of stormwater based on the seven types of pollutants that the NURP identified (Pitt, Maestre, & Clary, 2018). According to the National Research Council report (2008), the NPDES is comprehensive about stormwater quality. Still, there is great diversity in the standards used by MS4 permit holders for enforcement of the regulations. In other words, technical studies and technical data generally do not consider the institutional framework within which stormwater management is implemented.

The other type of literature that studies the consequences of states adopting stormwater management policies takes the form of case studies. For example, Rabe (1995) studied the permitting process in Minnesota and New Jersey and concluded that these states are limited in their permitting processes. Other researchers have investigated the outcomes of the application of stormwater management policies by states. For instance, Santhi, Srinivasan, Arnold, and Williams (2006) investigated the water quality management practices implemented in Texas. They found that the water quality management practices implemented successfully reduced pollution levels (up to 99%), in line with the limits set in state Total Maximum Daily Load standards. Although these studies indicate that there have been positive results in achieving

stormwater management policies in some states, it is impossible to generalize the results without considering the differences in the institutional frameworks between the states.

Therefore, two main gaps remain in the research literature on the states' role in achieving federal stormwater management policy goals. The first gap is centered around data on states' efforts to achieve the federal stormwater management policy goals. No correlation has been identified between these achievements and the institutional frameworks of the states. The second gap revolves around the limited generalization of studies that use the outputs of some states in case studies without considering institutional differences among states in implementing stormwater management policies. In this context, the current study fills these gaps by examining the impact of the state's type of institutional framework on achieving the goals of stormwater management policies. Specifically, this essay uses the type of institutional framework for implementing the MS4 permits adopted in each state to explain its performance in reducing the level of pollution in stormwater, in its effort to fulfill the goal of the Clean Water Act, aims to preserve the quality of water and avoid pollution.

3.3 The Proposed Theoretical Framework

The theory of local public economies developed by Elinor Ostrom and her colleagues looks at the process of dealing with environmental problems resulting from human diffusion through the principle of externalities. This approach sees regulatory activity as an effective means for internalizing the external costs of environmental impacts resulting from market economic activities (Oates & Portney, 2003). For example, when industrial waste produced by a factory begins to harm the environment, a means must be found to deal with the externalities left by this activity. According to Oates and Portney (2003), public economies theory argues that the ideal way to deal with the collective action problems is either by imposing taxes equal to the

social harm resulting from pollution activities or by imposing a permit system that determines a balanced proportion of economic efficiency and social harm. Searching for the appropriate balance between economic efficiency and social impact depends on knowing the economic and social costs associated with economic activity. Therefore, the theory of local public economies argues that regulation of the environmental pollution must be done in three levels: the constitutional level, where the rules are set to constitute the "collective choice" of the actors at lower levels; the collective choice level, where the arrangements and decisions are made regarding implementing the constitutional choice; and the operational levels, where the decisions are implemented in accordance with the arrangements and decisions that were made at the collective choice level (Cowie & Borrett, 2005). The constitutional choice establishes a standardized methodology that ensures that everyone shares the same outcomes within this arrangement. In addition, the collective choice implies that every actor would tailor constitutional requirements according to their needs by developing the necessary legislation, designing administrative institutions, and formulating institutional arrangements to achieve the constitutional goals. At the operational levels, the actors responsible for the implementation process formulate operation options to achieve their own goals within their activity domain. At the same time, they comply with the higher-level requirements.

One of the most prominent assumptions of this theory is that collective choices determine the end product of the policy. However, this assumption raises controversy about the centralization or decentralization of the institutional arrangement selected at the collective choice level. According to Oates and Portney (2003), centralization or decentralization of the institutional arrangements for implementing environmental policies are two sides of the same coin. On the one hand, from the decentralization point of view, decision-making should be

carried out by actors who implement policies within their activity domains because the cost and benefit are confined within their jurisdiction boundaries. On the other hand, from the centralization point of view, the decision-making should be unified across all jurisdictions to ensure policy goals and reduce opportunistic behaviors. Oates and Portney (2003) stated that the race to the bottom literature mixes these two arguments. The main argument is that states will adopt relaxed environmental legislation to compete with other states in attracting economic development; thus, states will opt for more institutional decentralization in enforcing national environmental policies, giving them an advantage in their competition with other states (Konisky, 2007). In other words, the states will give a high degree of discretion to local governments to meet the legal requirements associated with federal environmental legislation in order to attract economic development.

However, the relationship between centralization and decentralization and the impact on environmental policy outputs remains controversial. For example, Sigman (2005) studied the free-riding behaviors of states benefiting from the same water resources and found these behaviors were primary in the implementation of the CWA. The study included water quality data collected from 1973-1995 in 618 monitoring stations across all the states. Sigman (2005) argued that the discretion in implementation and enforcement of standards of the CWA allows states to engage in opportunistic behavior by lowering the level of environmental standards in their boundaries if the state upstream adopts higher standards. The underlying logic of such opportunistic behavior is that the benefits of the higher standards at the upstream state would extend to the downstream state; thus, the downstream state would not need to adopt higher standers. According to Sigman (2005), the study found evidence of such free-rider behaviors but indicated the results should not outweigh consideration of the benefits of decentralization.

Indeed, the benefits of decentralization in meeting local needs may outweigh the opportunistic behaviors of some states.

Similarly, Huang, Santibanez-Gonzalez, and Song (2018) employed a game-theoretical model to study the effects of the exchange of information between the federal and state governments on the cost of implementing environmental standards, and they argued that the state would hide the true cost to be able to implement lower standards compared to other states. Huang, Santibanez-Gonzalez, and Song (2018) stated that their game-theoretical model results indicated that interstate spillover of pollution is greater under conditions of states' control of the implementation process since they ignore the effect of their choices on the other states. In the same context, Millimet (2013) reviewed the empirical literature on the impact of decentralization on environmental policy outputs and concluded that "there is no empirical evidence to support the (intuitive) notion that subnational jurisdictions are better able to act on community preferences than the central government" (p. 1756). In other words, decentralization may not lead to the desired environmental results.

Regarding environmental policies related to water quality management, we find that water quality is characterized as a local public good. According to Oates and Portney (2003), water quality or lack of quality is of concern to local consumers as they are the primary beneficiaries or are affected by any change in water quality. Moreover, the cost associated with any water quality management measures is affected by the size of the local units as small local governments cannot bear the high cost of technologies as compared to large local governments (Oates & Portney, 2003). Sigman (2014) also studied the impact of the decentralization of water policies by analyzing the change in the water quality of rivers from 1979-1999 in 47 countries. Sigman (2014) found that the results did not support the race to the bottom theory (regulatory

competition). Moreover, Sigman (2014) stated that the empirical evidence indicated decentralization does not increase overall pollution. Therefore, the debate between centralization and decentralization in water quality policies tends to favor the decentralized approach.

Since stormwater is within the scope of water policies, I would argue that the institutional framework adopted by the state for stormwater management will influence the targeted outputs of stormwater management policies. In other words, the variation in stormwater quality can be explained in terms of the institutional framework followed by the states to implement public policies related to stormwater management. According to this view, it can be said that the disparities in the centralization and decentralization of the institutional frameworks followed in the states to implement constitutional policies related to stormwater management will affect the outcomes of these policies.

3.4 Research Design

To explore the variation in stormwater quality at the state level, a review of MS4 permit documents was conducted to determine the impact of institutional arrangement used by states to implement stormwater management policies (MS4 permits) on the quality of the state stormwater as reported by their 305(b)/303(d) impaired waters list. In other words, this study followed a qualitative approach to explore the relationship between the variation in the states' institutional arrangements and their stormwater quality. According to Ospina, Esteve, and Lee (2018), in the field of public administration, "methodologically robust qualitative studies help explain phenomena of importance to PA" (p. 601). In other words, qualitative studies contribute to enhancing our understanding of the phenomena of interest in the study of public administration as long as they follow a robust methodological process. Mele et al. (2020) indicated that the robust reporting of qualitative studies within the public administration field should include a

rationale for using the methodological process and for the selection of sources of data and analytic strategies and should observe ethical practices. Therefore, the following section presents details of the study methodology according to the framework of robust qualitative studies within the public administration field.

3.4.1 Data Description

3.4.1.1 Sample and Sample Selection

This study explores four case studies that include California, Texas, Virginia, and Minnesota. According to Adler (2009b), institutional arrangements for managing water issues vary according to the state regions as eastern states have a unified form of institutional arrangements, western states have multiple forms of institutional arrangements, and the rest of the states take the form of a mixture between the two. The four states comprising the sample for this study represent the rest of the states in their respective regions (note that this study divides the U.S. map into four regions instead of other traditional divisions, which can be found in other studies). The selected states share similar regional weather conditions with their neighboring states and are affected by similar externalities. In addition, each of these states contains internal variation in terms of the urbanization phase, which is related to stormwater quality. Finally, the states included in the sample vary in terms of their legislative frameworks, making them suitable for the analysis.

3.4.1.2 Data Generation

According to USEPA (n.d.), 47 states have assumed the authority to issue MS4 permits, and the agency manages the permit in three states: Massachusetts, New Hampshire, and New Mexico. The process of assuming the authority to issue permits includes the submitting of a proposal by the state to the USEPA, which in turn reviews the proposal; thus, if the USEPA

approves the proposed permit, the permit is granted to the state for a five-year period (USEPA, n.d.). However, not all states have implemented the issuance of permits at the same time. This, in turn, affected the permit cycle. For example, we may find some states have more than one cycle in stormwater permits—for one MS4 permit, the cycle is five years—and others have only one single cycle. In addition, the USEPA employs a five-year window for assessing whether permits meet the requirements of the CWA regardless of the cycle and the date of the permit (USEPA, n.d.). Therefore, this study employs a similar concept regarding the collection of data about the state's institutional arrangements, which means that the study selects a permit and performance report for review within a single historical cycle.

3.4.2 Data Sources and Analysis

3.4.2.1 Data Sources

The first source of the data is the general MS4 permits issued by the states during the cycle 2013 to 2018 (see Table 4.1). The reason for choosing this period is that data related to stormwater quality are limited, and states have different permit cycles. Therefore, this time window makes it possible to include all the data that result from the variation of the state permit cycles. The sampling period was from 2013 to 2018, and the sample included the latest active general MS4 permit in each state during the sampling period. According to Ospina, Esteve, and Lee (2018), analysis of government policy documents makes it possible to "identify mechanisms that could explain a surprising situation or outcome" (p. 601). In other words, policy documents can show the mechanisms that have been put in place to achieve the desired outcomes of the policy.

Purdy (2012) used policy documents and other resources to study power mechanisms between federal, states, and other stakeholders in the process of redesigning the rules for

hydroelectric licensing. Moreover, Keller and Cavallaro (2008) followed a similar method to study the variations in state government guidelines on implementing the waterbody 303(d) listing law (the states' listing of the impaired and threatened waters). In a study of stormwater, Grigg (2013) used a similar method to study the variation in financing stormwater management in over twenty MS4 cities in several states. Therefore, the use of policy documents to explain outcomes is well-rooted in the existing literature.

Table 3.1: The Sample States and Their General MS4 Permits for Review

State	General MS4 Permits	Authorization Cycle Starter
California	CAS000004	2013
Texas	TXR040000	2013
Virginia	9VAC25-890-40	2013
Minnesota	MNR040000	2013

The second data source is the reports from each state of their 305(b)/303(d) impaired waters lists. According to the USEPA (n.d.), in 1992, Part 130.7 was added to the Clean Water Act to require states to carry three new tasks: identifying waters that require a plan for restoring (total maximum daily load—TMDLs), determining the sources of pollution, and updating the impaired waters list every two years. Despite laws requiring the federal government to review and approve the list, states are responsible for determining sites and deciding how to measure water quality. Therefore, each state takes a certain approach to comply with these legislative requirements. For example, in California, the State Water Resources Control Board determines reporting periods for the nine regional boards; thus, in a cycle, water quality data are included for only some of the regional boards, and the next cycle would include data from other regions. Nevertheless, not all states identify sources of pollution. For example, California, Texas, and Virginia measure stormwater from urban areas for water quality pollutants. On the other hand,

the state of Minnesota indicates only the chemical components that are found in the analysis samples, which makes it difficult to determine the source of the chemicals. Considering these differences, this study reviews two different reports for each state (see Table 4.2). In some cases, the study compares the report results for the pre-permit adoption period with those for the post-permit adoption period. In other cases, it compares an early period of permit adoption with a later period of the permit adoption. The reason for this division is that states vary in their reporting periods.

Table 3.2: The Sample States and Their 305(b)/303(d) Impaired Waters Listing for Review

State	Report 1	Report Period	Report 2	Report Period
California	2014 and 2016 California Integrated Report Clean Water Act Sections 303(d) and 305(b)	2012-2014 and 2014-2016	2018 California Integrated Report	2016-2018
Texas	2014 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d)	2012-2014	2018 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d)	2016-2018
Virginia	Virginia Water Quality Assessment 305(b)/303(d) Integrated Report 2016	2009-2014	Virginia Water Quality Assessment 305(b)/303(d) Integrated Report 2020	2013-2018
Minnesota	2010 Minnesota Water Quality: Surface Water Section	2008 - 2009	2018 Minnesota Water Quality: Surface Water Section	2016 - 2017

3.4.2.2 Data Analysis

To explore how the institutional arrangements are made to enforce stormwater management policies in the states, this study analyzes stormwater permits along five dimensions that include permit formalism, coercion, education, prioritization, and accommodation (see Table 4.3).

Table 3.3: Evaluation and Comparison Dimensions

Dimension	Definition	Analytical Question	Example for Centralization	Example for Decentralization
Formalism	The emphasis State Government puts on detailing rigid legal requirements for the permittees (MS4 cities) regarding implementing the MS4 permit	How detailed is the MS4 permit regarding the implementation process?	Limiting the permittees' implementation discretion via detailed guidelines outlining the actions that the permittees should take specifically for each requirement	Giving the permittees some discretion over the implementation via general directives without a detailed definition of the actions
Coercion	The emphasis a State Government puts on issuing threats and sanctions during the implementation of the MS4 permit by the permittees (MS4 cities)	How coercion is the MS4 permit regarding the falling to meet the requirements?	Including a breakdown of the sanctions that are diverse in size and/or type	Including limited sanctions that are less diverse in size and/or type
Educational	The emphasis a State Government puts on educating the permittees (MS4 cities) regarding implementing the MS4 permit	How does the MS4 permit address the educational needs of the permittees (MS4 cities)?	Including educational requirements that permittees must meet	Including voluntary educational resources that permittees can utilize
Prioritization	The emphasis a State Government puts on considering contextual constraints during the implementation of the MS4 permit by the permittees (MS4 cities)	How does the MS4 permit address the contextual differences between the permittees (MS4 cities)?	Specifying the contextual constraints that can require a separate course of action and the required action in such events	Leaving the contextual constraints to the permittees' discretion
Accommodation	The extent to which a State Government emphasizes taking opinions of other stakeholders into account during the implementation of the MS4 permit by the permittees (MS4 cities)	How does the MS4 permit address the cooperation and collaboration between the stakeholders involved in the implementation process?	Specifying the permittee action regarding the relationship with stakeholders within their domain and their roles in the implementation process.	Presenting a voluntary course of action regarding the permittee relationship with stakeholders within their domain and their roles in the implantation process

Building on de Boer's (2019) work regarding frontline policy enforcement, this study uses the following analytical questions to guide the evaluation and comparison of the cases:

1- How detailed is the MS4 permit regarding the implementation process?

2- How coercive is the MS4 permit when there is a failure to meet the requirements?

3- How does the MS4 permit address the educational needs of the permittees (MS4 cities)?

4- How does the MS4 permit address the contextual differences between the permittees (MS4 cities)?

5- How does the MS4 permit address the cooperation and collaboration between the stakeholders involved in the implementation process?

According to Etienne (2015), any regulatory regime would include enforcement elements that ensure the desired outcome. Nevertheless, Carter (2017) stated that "regulatory approaches can be observed and measured through regulatory behaviors and practices" (p. 727). The regulatory behaviors include "tools or tactics used by an agency to bring about regulatee compliance" (Carter, 2017, p. 727). Moreover, Carter (2017) indicated that the study of regulatory enforcement varies from focusing on the regulatory agency as a unit of analysis to focusing on the individual street-level bureaucrat as a unit of analysis on the other end. However, Carter (2017) argued that there is confusion concerning how to study the regulatory behaviors of the regulatory agencies in terms of their strategy and legislative approaches. Furthermore, de Boer (2019) stated that the literature on individual street-level bureaucrats' regulatory enforcement behaviors had identified five main dimensions to measure the relationship between the enforcers of legislation and the regulated entities. These dimensions include formalism as "the degree of rigidity in interactions that varies from informal conversations and rule-bound instances" (May & Winter, 2000, p. 147, as cited in de Boer, 2019, p. 382), coercion as "the willingness to issue threats that vary from a trusting inspector not issuing warnings, to a skeptical

threatening to report or to impose penalties for violations" (May & Winter, 2000, p. 147, as cited in de Boer, 2019, p. 382), educational highlighted as "focusing on informing and educating inspectees during interactions" (de Boer, 2019, p. 383), prioritization "concerned with placing more emphasis on contextual circumstances and being effective than on other elements—like informing inspectees" (Tummers et al., 2015, as cited in de Boer, 2019, p. 383), and accommodation, which emphasizes "the reconciliation of the demands of key stakeholders in regulatory enforcement" (Lo et al., 2009, p. 2710, as cited in de Boer, 2019, p. 383). Therefore, this paper has adopted these well-established dimensions to analyze how the state in each case study established its institutional arrangements to enforce stormwater regulation, given that the states, by assuming authority to implement the regulation, are responsible for enforcing the regulation via writing and issuing the MS4 permits.

With regard to stormwater quality, this study tracks changes in the amount of pollution attributed to urban areas' stormwater as the MS4 legislation aims to reduce this type of water pollution. As mentioned previously, every state of the study sample includes information on stormwater pollution except for Minnesota. Thus, the study uses the number of times the turbidity impact (the measure of relative clarity of a liquid) was determined on the sample water bodies for the state of Minnesota. According to Métadier and Bertrand (2012), the turbidity measure is one of the most common methods of determining the impact of stormwater pollution. Therefore, the turbidity impact deduction in the case of Minnesota is used to represent the impact of stormwater pollution in the state's water bodies.

3.4.3 Ethical Considerations

Regarding ethical practices, Mele et al. (2020) indicated that researchers should discuss the ethical frameworks they have adopted in qualitative studies. This study did not contain any

human element that required Institutional Review Boards. In addition, this study details all its procedures, which will facilitate replication by other researchers. As well, the analytic strategies of the study did not include any coding process but only analytical questions. Therefore, there is no risk to any parties or entities related to this study or any potential bias threat.

3.5 Results and Discussion

3.5.1 Results

Based on the information in Table 4.4, it can be seen that the states that were included in the study sample differ along the five analysis dimensions. The arrangements in the states ranged from a highly centralized institutional arrangement for implementing stormwater regulation, as was the case with California, to a very decentralized institutional arrangement, as was the case with Texas. In addition, other states adopted a mixed institutional arrangement for implementing stormwater regulation that might in some cases tend toward being central, as was the case with Minnesota. In other states, arrangements tended to be less centralized, as was the case with Virginia. Each state institutional arrangement for implementing stormwater regulation is discussed in detail below.

3.5.1.1 California

California was one of the first states to adopt legislation to deal with stormwater. In 1949, California passed the Dickey Water Pollution Act, which established the State Water Pollution Control Board (SWRCB) and nine regional boards to oversee and enforce the state's pollution prevention and abatement program (Water Education Foundation, 2013). The SWRCB was responsible for enforcing the state's anti-pollution program. In addition, California passed the Porter-Cologne Water Quality Control Act of 1969, which increased the power of the SWRCB in regard to pollution prevention..

Table 3.4: States' Institutional Arrangements for Implementing Stormwater Regulation

Dimension	California	Texas	Virginia	Minnesota
Formalism	Uses numerical and quantifiable approaches for the specific stormwater controls or management measures with detailed guidelines outlining the actions that the permittees should take specifically for each requirement (CAS000004, 2013, sections: E.6.a.(ii)(h), E.9.c.(ii)(a), E.9.c.(ii)(b) & E.12.e.(ii)(c))	Uses a narrative standard approach for regulating the MS4 local governments without detailed guidelines outlining the actions of the permittees (TXR040000, 2013, Part II.D.4., & Parts III.B.4.(a))	Uses a mix of a numerical/quantifiable approach and a narrative standard approach for regulating the MS4 local governments with a limited detailed guide outlining the actions of the permittees (9VAC25-890-40, 2013, Sections: I.C.2.(a) (1-12), and II.B.1.(3) (c))	Uses a mix of a numerical/quantifiable approach and a narrative standard approach for regulating the MS4 local governments with detailed guidelines outlining the actions of the permittees (MNR040000, 2013, Parts: III.F.2.(a), III.F.2.(d), & III.D.3.(g))
Coercion	Includes a breakdown of the sanctions but not information on how/when to use them (CAS000004, 2013, sectiona: E.6.a.(ii)(i-j), & E.6.c.(ii)).	Does not provide a breakdown of all the procedures that the MS4 local government should follow to detect non-compliance (TXR040000, 2013, Part III.A.3.(a) (2) (j- h), Part III.A.6., & Part IV.B)	Encourages progressive compliance and enforcement strategy, but does not provide a breakdown of all the procedures that the MS4 local government should follow to detect non-compliance (9VAC25-890-40, 2013, Sections: II.B.1.(3)(b) & II.B.1.(4)(c)(8))	Provides a limited breakdown of all the procedures that the MS4 local government should follow in case it detects a case of non-compliance (MNR040000, 2013, Parts: II.D.3& III.B.2)
Education	Requires certification for stormwater-related employees (CAS000004, 2013, section: E.7.b.(2)).	Does not require any certification or qualification required for the MS4 local government stormwater-related employees (TXR040000, 2013, Part III.B.2.(c)(2) & Part III.B.3.(b)(7))	Requires certification for stormwater-related employees (9VAC25-890-40, 2013, Section: II.B.1.(4)(c)(3))	Does not require any certification or qualification required for MS4 local government stormwater-related employees (MNR040000, 2013, Part III.D.6. (g)(1-3))
Prioritization	Gives a waiver option, but it is up for review every year and subject to fees (CAS000004, 2013, sections: A.3.b.(3) & A.3.a.).	Has different MS4 local government categories, different waiver options, and no annual waiver evaluation and fees (TXR040000, 2013, Part II.A.5., Part II.B., Parts II.E.6.(a), Part II.E.10., & Part II.E.13.)	Does not provide details about the waiver option but allows changes and implementation transfer (9VAC25-890-40, 2013, Sections: II.B.1.(6)(D) and II.B.1.(6)(F)(1)(a))	Does not provide details about the waiver option but allows changes and implementation transfer (MNR040000, 2013, Parts: I.D. & III.G.3).
Accommodation	Adopts formal institutions in the form of regional water boards to address the stakeholders' opinions (CAS000004, 2013, section: G.).	Requires legislative due process, and calls for considering entering cooperative relationships among the subjected MS4 local government (TXR040000, 2013, Part II.E.16.(b-j), Part III.A.3.(a) (2)(i), Part III.B.1.(a)(5))	Requires formal collaboration and legislative due process (9VAC25-890-40, 2013, Sections: I.B.2.(a), II.B.1.(2)(c), and I.C.2.(b) (3))	Requires legislative due process and annual public input but does not present any proposed framework for cooperation (MNR040000, 2013, Parts: II.D.1 & III.D.2.(a)(1)).

Since then, the California SWRCB has become a major player in implementing federal stormwater management policies. According to Cousins (2017a), the State Water Resources Control Board is responsible for setting the regulatory guidelines of the stormwater permits, while the Regional Boards hold the authority to incorporate additional requirements and to grant permits to the regulated entities within their jurisdictions; thus, the regulated entities are under a dual authority. For example, the MS4 local government is subject to a state permit and special requirements that have been established for the permit issued to it by the board for the region in which it is located. However, this study reviews only the statewide MS4 permit, or the CAS000004 of 2013, since the regionally-specific permit requirements may contain variations according to the challenges faced by each region, making it difficult to obtain a full picture of the institutional arrangements of all local governments subject to MS4 regulation

3.5.1.1.1 Formalism

Formalism in the context of this study refers to the way the state government crafts the language of its MS4 permit. Specifically, this review aims to answer the following question: How detailed is the MS4 permit regarding the implementation process? Based on the California CAS000004 MS4 permit, it can be stated that the state is following a more numerical and quantifiable approach for the specific stormwater controls or management measures. The permit gives the MS4 local governments detailed requirements and specifies the actions that they must adopt in their local ordinances and practices framed by a specific time frame for implementing the program. For example, the permit requires the MS4 local governments to adopt local ordinances according to the following specification:

1) Effectively require the discharger to abate and clean up their discharge, spill, or pollutant release within 72 hours of notification; high-risk spill should be cleaned up as soon as possible.

2) Require abatement within 30 days of notification, for uncontrolled sources of pollutants that could pose an environmental threat. (CAS000004, 2013, section: E.6.a.(ii)(h)).

These requirements should be formulated by the MS4 local government ordinances, which would limit local governments to have discretion over the implementation. Concerning the education process, we found that a statement requires the local government to carry out approximately 12 types of activities related to the education process, which vary from developing a specific awareness-raising message to a request to measure the level of community awareness through a survey conducted every two years. Nevertheless, the MS4 permit provides a set of requirements to teach and train local government employees and targeted groups for implementation (like contractors, developers… etc.) working within the boundaries of the desirable government authority. Moreover, MS4 local governments are required to conduct a stormwater quality test within a three-day period of the occurrence of rain according to a set of numerical standards and measures specified in Sections E.9.c.(ii)(a) and E.9.c.(ii)(b). For example, the MS4 local government is required to conduct an analysis to ensure that ammonia does not exceed 50 mg/L in the sample subject to analysis. In addition, MS4 permits provide about twelve kinds of post-construction stormwater management requirements, along with subsequent requirements under each implementation action. The post-construction stormwater management requirements also function as volume-based performance standards for new development, as presented in Section E.12.e.(ii)(c).

3.5.1.1.2 Coercion

This section is dedicated to reviewing the way states deal with noncompliance. The study seeks to answer the following question: How is non-compliance addressed in the MS4 permit? On the basis of the California CAS000004 MS4 permit, it can be seen that the permit provides a

breakdown of all the procedures that the MS4 local government should follow if it detects a case of non-compliance. The MS4 requires the MS4 local government to develop a Permittee Enforcement Response Plan that levies citations, administrative fines, civil sanctions, or criminal sanctions (CAS000004, 2013, Section E.6.a.(ii)(i-j)). Further, the MS4 permit provides a breakdown of the sanctions, which include verbal warnings, written notices, monetary fines, civil and administrative penalties, stop-work orders, and/or withholding of plan approvals or other authorizations (CAS000004, 2013, Section E.6.c.(ii)). However, the MS4 permit does not determine the size of any of these penalties or a specification of the cases in which each type should be used.

3.5.1.1.3 Education

This part of the analysis reviews how the permits address the educational needs of the MS4 local government as the program's implementation may require skills ranging from legal and administrative skills to environmental science specialization. The California CAS000004 MS4 permit addresses the educational needs of the MS4 local government by requiring the stormwater employee to be a certified Storm Water Pollution Prevention Plan (SWPPP) Developer (QSD) or an SWPPP Practitioner (QSP) (CAS000004, 2013, section: E.7.b.(2)). By including these requirements, the permit requires that the workers who implement it have a degree of qualification that enables them to carry out the necessary tasks. Moreover, the MS4 permit requires that employees with each type of qualification assume different roles as QSDs to supervise plan reviews or as QSPs to supervise inspection operations. In addition, the California Water Boards (n.d.) identify nine organizations in which MS4 local government employees can enroll in programs to obtain certification. Finally, the MS4 permit does not require the MS4 local government employees to obtain any training from the state government agency.

3.5.1.1.4 Prioritization

Prioritization relates to how the MS4 permit addresses the contextual differences between the permittees. The California CAS000004 MS4 permit addresses the contextual differences between the permittees as stated in the following:

> Small MS4s face highly variable conditions both in terms of threats to water quality from their storm water discharges and resources available to manage those discharges. Therefore, one set of prescriptive requirements is not an appropriate regulatory approach for all Regulated Small MS4s. (p. 9)

In other words, the permit indicates that there are differences among the local governments that are subject to legislation. To address such differences, the MS4 permit provides a waiver option for "communities outside of urbanized areas with a population of 20,000 or less with an annual median household income (MHI) that is less than 80 percent of the statewide annual MHI" (CAS000004, 2013, p.9). However, the MS4 permit links the waiver granted to a set of other requirements such as not contributing to the emission of the pollutant or determining that storm water BMPs are not needed (CAS000004, 2013, Section A.3.b.(3)). However, such local governments would have to submit an annual waiver request and pay any fees and any other "applicable surcharge" (CAS000004, 2013, Section: A.3.a.). Therefore, the waiver status of MS4 local governments is under review annually.

3.5.1.1.5 Accommodation

Since stormwater quality is a collective action problem, it requires the cooperation and collaboration between the stakeholders engaged in the implementation process to achieve the policy outcomes; therefore, this section concerns the MS4 permit's response to this need, formally or informally. Although California's CAS000004 MS4 permit acknowledges the need for "close collaboration and cooperation among the Permittees" and other agencies, it adopts formal mechanisms for addressing the cooperation and collaboration needs by giving the

Regional Water Boards the authority for "reviewing reports, requiring modification to stormwater program components and various submissions, imposing region-specific monitoring requirements, conducting inspections and program evaluations (audits), taking enforcement actions against violators" (CAS000004, 2013, Section G.). In other words, the Regional Water Boards oversee the action of the MS4 local governments and ensure that their behavior is in line with the permit requirements. The role of the State Water Pollution Control Board is limited to setting policies and resolving disputes that may arise between the Regional Water Boards and the MS4 local governments.

3.5.1.1.6 Stormwater Quality Status

Table 4.5 represents the status of stormwater quality in the state of California. It should be noted that the state of California issued a report that combines data from the years between 2014 and 2016 and includes six regions, as follow:

> Regional Water Quality Control Boards (Regional Water Boards) for the San Francisco Bay (Region 2), Central Coast (Region 3), Los Angeles (Region 4), Central Valley (Region 5), Santa Ana (Region 8), and San Diego (Region 9) regions. (p. ii)

In addition, the 2014/2016 report included baseline information for the regions that were not included in these reporting cycles. On the other hand, the 2018 report includes the remaining regions with an update of the status of the first six regions. Thus, both reports include the status of state water quality regardless of the region.

On the basis of the information in Table 4.5, it is clear that in 2014/2016 (a total of four years of monitoring), the level of detected stormwater pollution was low since there was a detected in only approximately 5% of the water segments/events assessed for water quality. At the other end of the scale, in the 2018 report, the level of detection of stormwater pollution was higher. It was detected in over 6% of the water segments/events assessed of water quality.

Although it cannot be ascertained whether these differences are statistically significant or valid to establish causality, these reports indicate that within the four years of 2012-2016, 313 pollutants were detected, while in only the two years of 2016-2018, 269 were detected. This increase may have been caused by urban expansion or a change in monitoring density. However, these possible reasons cannot negate the fact that there has been an increase in the number of cases of stormwater pollution.

Table 3.5: California Stormwater Quality Status

Year	Total Number of Assessment Units for Impairments	Pollution Detected from Urban Runoff/Storm Sewers and Industrial/Commercial Site Stormwater Discharge	Total Number of Segment Impairments
2014/2016	6,043 water segments/events	313 water segments/events	4,367 water segments
2018	4,373 water segments/events	269 water segments/events	4,368 water segments

3.5.1.2 Texas

Texas administers stormwater regulation through a single state agency named the Texas Commission on Environmental Quality (TCEQ), which issues and oversees the implementation of the state MS4 permit No. TXR040000 through its regional offices. According to the US Environmental Protection Agency (2016), the Texas MS4 permit does not contain any common legal constraints similar to those in the rest of the states, such as “on-site retention/volume control, treatment requirement, channel protection requirement, flood control requirement, redevelopment standard, special criteria, or offset /mitigation” (p. 106). Considering the differences in Texas MS4 permits, this study reviews the statewide MS4 permit, which is TXR040000 from 2013.

3.5.1.2.1 Formalism

Texas MS4 permit No. TXR040000 follows a narrative standard approach for regulating

the MS4 local governments within the state. The permit does not give the MS4 local governments detailed requirements or specify actions that they must adopt in their local ordinances and/or practices to implement the program. On the other hand, the MS4 permit makes narrative requirements subject to the MS4 local government's discretion. For example, the permit requires the subject MS4 local government to develop a Stormwater Management Program (SWMP) that includes targeted controls, measurable goals, identification of benchmarks, and other best management practices (BMPs) (TXR040000, 2013, Part II.D.4.). However, none of these requirements includes the specification of numerical values or quantifiable measures of any element of the SWMP. Another example of such a narrative standard approach is seen in the requirements for the post-construction program, for which the permit states that permittees should develop, implement, and enforce such program, but it does not provide any numerical values or quantifiable measures (TXR040000, 2013, Parts III.B.4.(a)).

3.5.1.2.2 Coercion

Texas MS4 permit No. TXR040000 does not provide a breakdown of all the procedures that the MS4 local government should follow if it detects a case of non-compliance. However, the MS4 permit requires the MS4 local government to develop a standard operating procedure (SOP) that include some penalties, whether monetary, civil, or criminal, in their local ordinances (TXR040000, 2013, Part III.A.3.(a) (2) (j- h), & Part III.A.6.). The MS4 permit does not provide details regarding how or when such actions should be enforced. On the other hand, the MS4 permit requires the MS4 local government to report any non-compliance event to the TCEQ Regional Office and the TCEQ Enforcement Division within no more than five days of the event (TXR040000, 2013, Part IV.B). Such legal requirements place the state agency at the center of any violation of the permit requirements.

3.5.1.2.3 Education

Texas MS4 permit No. TXR040000 does not require any certification or qualification for the MS4 local government stormwater-related employees. On the contrary, the permit requires the MS4 local governments to subject the personnel involved in stormwater management to a training course according to their discretionary needs and subject to state agency review if needed (TXR040000, 2013, Part III.B.2.(c)(2) & Part III.B.3.(b)(7)). In other words, the MS4 local government determines its training needs and designs or pays for a training program that covers this need and enrolls employees in these programs. Nevertheless, the state agency reserves the right to review the training programs if it deems this necessary.

3.5.1.2.4 Prioritization

Texas MS4 permit No. TXR040000 divides MS4 local governments into four categories according to the population size, as follow: Level 1 designates an urban area that has a population of less than 10000, Level 2 designates an urban area that has a population of at least 10000, but less than 40000, Level 3 designates an urban area that has a population of at least 40,000 but less than 100,000, and Level 4 designates an urban area that has a population of 100,000 or more (TXR040000, 2013, Part II.A.5.). In addition, the MS4 permit recognizes the fact that these levels are subject to change due to any possible acquiring or giving up land via the annexing processes. Moreover, the MS4 permit offers two options for waiving the requirements for MS4 local governments: the first is for governments with a population of less than 1,000, and it does not require a review by the state agency; the second is for governments whose population is less than 10,000, and it requires a state agency review to determine that controls are not needed (TXR040000, 2013, Part II.B.). The MS4 permit does not require any fees or annual renewal for waivers (TXR040000, 2013, Part II.E.13.). Further, the Texas MS4 permit gives

MS4 local governments the freedom to make changes without referring to the state agency in a number of cases involving adding additional controls, areas, or adding clarifications to other existing BMPs (TXR040000, 2013, Parts II.E.6.(a)). MS4 local governments can also change their responsibility for the implementation and transfer it to other entities after informing the state agency that they will do so (TXR040000, 2013, Part II.E.10.).

3.5.1.2.5 Accommodation

The Texas MS4 permit addresses the stakeholders' opinions within the MS4 local government domain via certain requirements. First, local governments must follow the legislative due process by carrying out actions such as publishing a notice and receiving and responding to public comments (TXR040000, 2013, Part II.E.16.(b-j)). Second, the MS4 permit calls on MS4 local governments to adopt ordinances that consider the possibility of entering into cooperative relationships with other MS4 local governments (TXR040000, 2013, Part III.A.3.(a)(2)(i)). Finally, collaboration is directly encouraged through the inclusion of the following statement in the permit: “MS4 operators may partner with other MS4 operators to maximize the program and cost effectiveness of the required outreach” (TXR040000, 2013, Part III.B.1.(a)(5)). In other words, the permit suggests that local governments can overcome the cost of implementation and increase effectiveness through cooperation.

3.5.1.2.6 Stormwater Quality Status

Table 4.6 presents the status of stormwater quality in the state of Texas. On the basis of its content, it is evident that the level of deducted stormwater pollution in 2014 was high since it was detected in about 77.78% of the water segments/events that were assessed for water quality. On the other end, in the 2018 report, the level of detected stormwater pollution was lower. It was detected in about 70% of the water segments/events assessed for water quality. The 2018 report

indicated that the state was able to reduce the level of detected stormwater pollution by about 11% as compared to the 2014 report. Although it cannot be ascertained whether these differences are statistically significant or valid to establish causality, these reports indicate that Texas witnessed a decrease in stormwater pollution.

Table 3.6: Texas Stormwater Quality Status

Year	Total Number of Assessment Units for Impairments	Pollution Detected from Urban Runoff/Storm Sewers and Industrial/Commercial Site Stormwater Discharge	Total Number of Segment Impairments
2014	986 water segments/events	767 water segments/events	589 water segments
2018	979 water segments/events	685 water segments/events	583 water segments

3.5.1.3 Virginia

The Virginia Department of Environmental Quality administers the Commonwealth's statewide stormwater program, named the Virginia Stormwater Management Program. In addition, the Virginia Department of Environmental Quality issues and oversees the statewide stormwater MS4 permit No. 9VAC25-890-40 of 2013. According to Nobles, Goodall, and Fitch (2017), the Virginia Stormwater Management Program gives customers credit toward their utility fees if they have implemented measures limiting stormwater pollution in their establishments. For example, if a private or commercial real estate owner has installed some green practices to clean stormwater or reduce its flow, the owner may receive a utility credit. Considering the progressiveness of the Virginia Stormwater Management Program, this study reviews the statewide MS4 permit, which is 9VAC25-890-40 of 2013.

3.5.1.3.1 Formalism

The Virginia MS4 permit No. 9VAC25-890-40 follows a mix of a numerical/quantifiable approach and a narrative standard approach for regulating the MS4 local governments within the

state. For example, the permit provides set limits on the levels and types of pollution that the local government must enforce and provides guidance on how to estimate the existing source loads and the reductions required (9VAC25-890-40, 2013, Sections I.C.2.(a) (1-12)). On the other hand, the MS4 permit gives a narrative standard of the other stormwater management requirements. For example, the permit does not give numerical or quantifiable requirements for illicit discharge screening and detection (9VAC25-890-40, 2013, Section II.B.1.(3) (c)). It should be noted that the focus in the state program is on treatment standards (US Environmental Protection Agency, 2016); thus, the use of a numerical/quantifiable approach was limited on purpose to give more discretion to the MS4 local government regarding the practices of implementing the permit requirements.

3.5.1.3.2 Coercion

Virginia MS4 permit No. 9VAC25-890-40 does not provide a breakdown of all the procedures that the MS4 local government should follow if it detects a case of non-compliance. By contrast, the permit requires MS4 local governments to put in place measures to investigate and limit pollution (9VAC25-890-40, 2013, Section II.B.1.(3)(b)). The MS4 permit encourages the MS4 local governments to adopt a "progressive compliance and enforcement strategy" in their local ordinances to ensure implementation of the stormwater standards (9VAC25-890-40, 2013, Section II.B.1.(4)(c)(8)). However, the MS4 permit does not explain how such progressive strategies should be implemented.

3.5.1.3.3 Education

Virginia MS4 permit No. 9VAC25-890-40 requires a certification for the MS4 local government stormwater-related employees who are responsible for the task of carrying out inspections (9VAC25-890-40, 2013, Section: II.B.1.(4)(c)(3)). According to Virginia

Administrative Code 9VAC25-850-50 (n.d.), stormwater-related employees can be certified after completing 800 hours of experience or 12 months of a board-approved training program. Further, Virginia Administrative Code 9VAC25-850-50 (n.d.) indicates that the stormwater plan reviewer and stormwater inspector need to receive different certifications. In other words, the Virginia Stormwater Management Program distinguishes between the different educational needs of different practitioners in stormwater management jobs.

3.5.1.3.4 Prioritization

Virginia MS4 permit No. 9VAC25-890-40 gives the MS4 local governments the ability to change their responsibility for the implementation and transfer it to other entities after informing the state agency that they will do so (9VAC25-890-40, 2013, Sections: II.B.1.(6)(D)). However, the MS4 permit does not exempt the government from being subject to penalties for non-compliance or to legal liability if a case of non-compliance occurs. In addition, the MS4 permit gives MS4 local governments the freedom to make changes without reporting them to the state agency in a number of cases involving adding additional controls or areas or adding clarifications to other existing BMPs (9VAC25-890-40, 2013, Sections: II.B.1.(6)(F)(1)(a)). Finally, the Virginia MS4 permit does not provide details about exemptions for local governments from the permit requirements.

3.5.1.3.5 Accommodation

Virginia MS4 permit No. 9VAC25-890-40 recognizes the stakeholders' opinions within the MS4 local government domains in different forms. The MS4 permit recognizes that inter-jurisdictional agreements can be utilized to address the permit requirements (9VAC25-890-40, 2013, Sections: I.B.2.(a)). In addition, the MS4 permit asks MS4 local governments within the same basin to implement a plan to manage stormwater collectively via establishing a

memorandum of understanding (MOU) between the MS4 operators (9VAC25-890-40, 2013, Section I.C.2.(b) (3)). Finally, the MS4 permit requires the MS4 local governments to follow due process when adopting their stormwater plans (9VAC25-890-40, 2013, Section II.B.1.(2)(c)).

3.5.1.3.6 Stormwater Quality Status

Table 4.7 presents the status of stormwater quality in the state of Virginia. Virginia has issued a direct comparison between pollution levels of urban stormwater and other pollutants from other areas, such as the agricultural sector. Virginia measures stormwater pollution according to three criteria: nitrogen, phosphorus, and sediment. The information in Table 4.7 shows that the level of detected stormwater nitrogen pollution in the 2009-2014 report was higher (over 17%) than it was in 2013-2018 (over 14%). In other words, the stormwater nitrogen pollution in the 2013-2018 report is lower than it was in the past. However, stormwater phosphorus pollution rose in the same period.

Table 3.7: Virginia Stormwater Quality Status

	Units	2009-2014	2013-2018	Change
Total VA Land Area #	Acres	2,528,960	2,898,471	369511
% of VA Land	%	10.09	11.6	1.51
Total Nitrogen	10^6 Kg/year	5.42	9.2	3.78
% of all other sources	%	17.20	14.3	-2.9
Total Phosphorus	10^6 Kg/year	0.51	1.0	0.49
% of all sources	%	22.98	29.5	6.52
Total Sediment	10^6 Kg/year	0.12	185	184.88
% of all sources	%	4.04	7.7	3.66

According to the 2009-2014 report, the stormwater phosphorus pollution was about 23%, but it increased to about 30% according to the 2013-2018 report. Similarly, stormwater sediment pollution increased in the 2013-2018 report to about 8% compared to 4% in the 2009-2014

report. Although it cannot be ascertained whether these differences are statistically significant or valid to establish causality, these reports indicate that Virginia witnessed an increase in some aspects of stormwater pollution while witnessing a decrease in others.

3.5.1.4 Minnesota

The Minnesota Pollution Control Agency administers the statewide stormwater program and issues the state MS4 permit No. MNR040000. Minnesota is one of the states that has established independent institutions; the Minnesota GreenStep Cities Program brings together many government and non-government institutions to support local governments in adopting sustainable environmental practices, including stormwater management practices (Minnesota GreenStep, n.d.). Via the Minnesota GreenStep Cities Program, MS4 local government has access to management experiences and practices followed by similar governments to ensure permit compliance. With a focus on volunteer compliance by the state agency, this study reviews the statewide MS4 permit, which is MNR040000 of 2013.

3.5.1.4.1 Formalism

Minnesota MS4 permit No. MNR040000 follows a mix of a numerical/quantifiable approach and a detailed narrative standard approach for regulating the MS4 local governments within the state. The Minnesota MS4 permit requires the MS4 local government to follow numerical/quantifiable limitations on discharge to stormwater (MNR040000, 2013, Part III.F.2.(d)). In addition, the numerical standards are followed by a detailed explanation of the expected implementation process along with required timing and sampling procedures (MNR040000, 2013, Part III.F.2.(d) & Part III.F.2.(a)). Thus, the Minnesota MS4 permit differs from the Virginia MS4 permit in that it uses narrative standards to support numerical/quantifiable standards.

3.5.1.4.2 Coercion

The Minnesota MS4 permit No. MNR040000 provides a limited breakdown of all the procedures that the MS4 local government should follow in case it detects a case of non-compliance. The MS4 permit requires the MS4 local governments to adopt Enforcement Response Procedures, which should be enforced in the event of non-compliance (MNR040000, 2013, Part II.D.3). The MS4 permit requires the MS4 local governments to document any violation under the process indicated by the permit, which includes filing the date and location, a description of the violation, and enforcement actions "(e.g., written notice, citation, stop-work order, withholding of local authorizations, etc.)" (MNR040000, 2013, Part II.B.2.). Therefore, it is clear that the Minnesota MS4 permit provides a limited breakdown of the required coercion that the MS4 local governments can follow to ensure compliance with the permit.

3.5.1.4.3 Education

Minnesota MS4 permit No. MNR040000 does not require any certification or qualification for MS4 local government stormwater-related employees. However, the permit requires the MS4 local governments to subject the personnel involved in stormwater management to a training course according to a set of narrative standards such as that the training program "addresses the importance of protecting water quality" and "cover the requirements of the permit relevant to the job duties" (MNR040000, 2013, Part III.D.6. (g)(1-3)). Nevertheless, the MS4 permit does not indicate that the state agency reserves any the right to review the training programs of the MS4 local governments.

3.5.1.5 Prioritization

Minnesota MS4 permit No. MNR040000 gives MS4 local governments the ability to change their responsibility for implementation and transfer it to other entities after informing the

state agency that they will do so (MNR040000, 2013, Part I.D.). In addition, the MS4 permit gives MS4 local governments the freedom to make changes without reporting this to the state agency in a number of cases involving adding additional controls or areas or the addition of clarifications to other existing BMPs (MNR040000, 2013, III.G.3). Finally, the MS4 permit does not provide details about exemptions for local governments from the permit requirements.

3.5.1.5.1 Accommodation

Minnesota MS4 permit No. MNR040000 recognizes the stakeholders' opinions within the MS4 local government domain in different forms. The MS4 permit recognizes that inter-jurisdictional agreements can be utilized to address the permit requirement (MNR040000, 2013, Part II.D.1). In addition, the MS4 permit requires MS4 local governments to follow due process when adopting their stormwater plans, as well as giving the “opportunity annually for the public to provide input on the adequacy” of their plans (MNR040000, 2013, III.D.2.(a)(1)). Finally, the Minnesota MS4 permit does not present any proposed framework for cooperation between MS4 local governments.

3.5.1.5.2 Stormwater Quality Status

Table 4.8 represents the status of stormwater quality in the state of Minnesota. The information in Table 4.8 makes it clear that the level of detected turbidity stormwater pollution in 2010 was high since it was detected in about 33% of the water segments/events that were assessed for water quality. On the other end, in the 2018 report, the level of detected turbidity stormwater pollution was lower since it was detected in about 21% of the water segments/events that were assessed for water quality. Although it cannot be ascertained whether these differences are statistically significant or valid to establish causality, these reports indicate that Minnesota witnessed a decrease in stormwater pollution.

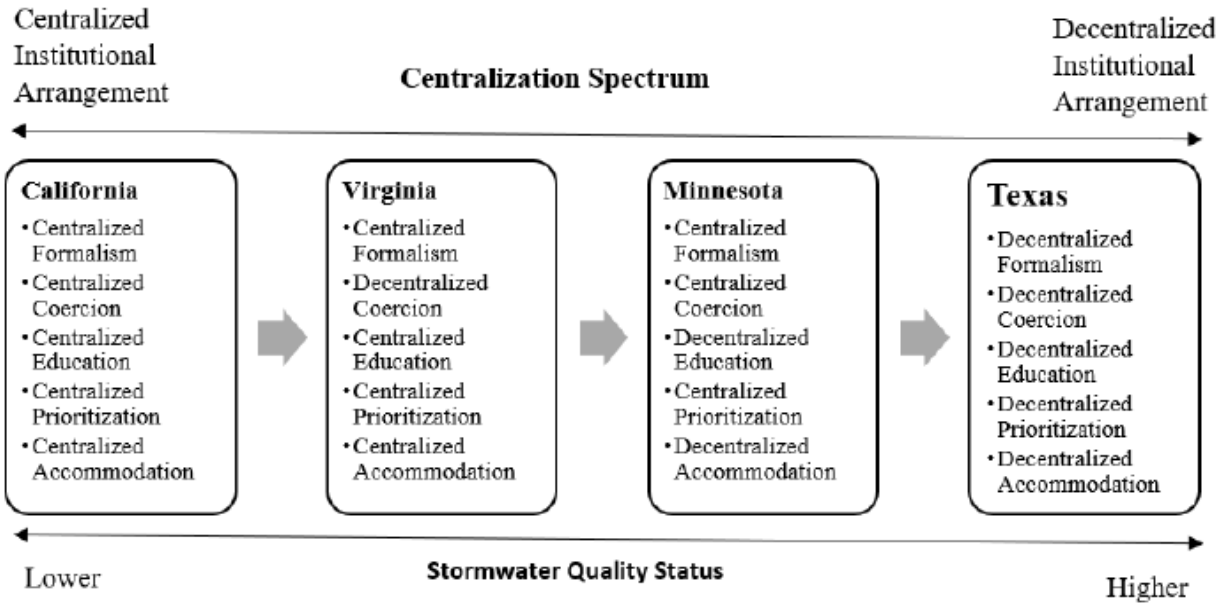
Table 3.8: Minnesota Stormwater Quality Status

Year	Total Number of Assessment Units for Impairments	Turbidity Pollution Deducted	Total Number of Segment Impairments
2010	17,684 water segments/events	5,887 water segments/events	11,559 water segments
2018	26,797 water segments/events	5,704 water segments/events	16,787 water segments

3.5.2 Discussion

The information in Figure 3.1 makes it clear that there is a centralization spectrum in the institutional arrangements adopted by states to implement stormwater regulation. Starting with the most centralized institutional arrangement, that of California, the discretion of MS4 local governments is highly restricted. For example, the California MS4 permit takes a detailed guideline approach with numerical and quantifiable standards that would limit the ability of MS4 local governments to align legal requirements with local needs. In addition, the California MS4 permit establishes detailed requirements regarding the process of enforcing the legislation and dealing with non-compliance that may limit the ability of MS4 local governments to build a collaborative implementation relationship with their citizens who are subject to compliance. The California MS4 permit also requires MS4 local governments to subject their staff to an accreditation procedure, which will raise the cost of running the program by requiring the obtaining of qualified staff and assisting them in maintaining their qualifications; thus, it will add a financial burden that local governments must bear. The California MS4 permit increases the financial burden of the exempt MS4 local governments via the annual application requirements and the waiver fees. Finally, the California MS4 permit formalizes any collective action by delegating enforcement and monitoring powers to regional boards; thus, MS4 local governments do not have the power to decide whether or not to cooperate and be subject to power struggles within the regional organization.

Figure 3.1: The Stormwater Institutional Arrangement Centralization Spectrum



Similarly, both Virginia and Minnesota have adopted somewhat centralized institutional arrangements to implement stormwater regulation. However, the Virginia MS4 permit is more centralized than the Minnesota MS4 permit as it decentralizes only the enforcement requirements while centralizing all the other dimensions of the permit. Although the Virginia MS4 permit encourages progressive compliance, it does not place any requirements (limitations) the local government must follow in the enforcement or in cases of non-compliance; thus, the local governments have some authority to adopt enforcement methods that suit their own needs. In contrast, the Minnesota MS4 permit centralizes the enforcement aspect, but it decentralizes the employees' qualification requirements and the cooperation decisions between the MS4 local governments. Such decentralization can reduce financial burdens and may contribute to building a cooperative relationship of a voluntary nature among members.

California, Virginia, and Minnesota coincide on one issue: the inclusion of volumetric requirements in their permits. Despite the risks associated with this type of centralization of stormwater quality requirements, some researchers believe that such a volumetric approach to

controlling stormwater can help to combine technical needs and political interests (Cousins, 2017b). However, Cousins (2017b) points out that such a volumetric approach must take into account local needs as well as environmental needs. In other words, the decision of a particular party to deal with stormwater through volume measurement (e.g., by discharging 30% in redirection to another party) may lead to repercussions for society and the environment. In this regard, Porse and Pincetl (2018) studied the impact of volumetric stormwater practices in Los Angeles upstream on the downstream basins. According to Porse and Pincetl (2018), practices at Los Angeles upstream basins impacted the level of streamflow, which in turn has affected the amount of water available to support aquatic habitats and other uses in the downstream basins. On the other hand, Harmel et al. (2016) stated that the measuring of pollution levels in storm water faces many dilemmas that make accurate measurement difficult to achieve. Therefore, the inclusion of many volumetric standards may create another dilemma with negative impacts on the environment and society.

In contrast to other states, Texas has adopted a decentralized institutional arrangement to implementing stormwater regulation. The Texas MS4 permit follows a narrative standard approach, and it does not place any precedent on local governments in terms of enforcement, training, or cooperation. Nevertheless, the Texas MS4 permit is the most prioritized toward the local level as it divides the types of MS4 cities into four levels and reduces the requirements for exceptions. In addition, according to the USEPA (2016), the narrative standard approach is commonly used in many states, including Alabama, Illinois, Arkansas, Louisiana, New Mexico, Oklahoma, Iowa, Kansas, Missouri, Nebraska, South Dakota, Wyoming, Arizona, Hawaii, Alaska, Idaho, and Oregon. These states represent nearly half of the states that have assumed the authority to enforce stormwater legislation. However, it must be taken into account that each

state follows certain methods concerning other aspects of implementation, such as enforcement, training, or cooperative relations.

In relation to the stormwater quality, the review of the stormwater permits in the four case studies presented above corresponds to the theoretical framework of this study, which proposes that the outputs of stormwater management policies are affected by the institutional arrangements adopted by the states. As evident from the changes in stormwater quality (the amount of pollution produced by stormwater), the changes in the institutional frameworks used to implement stormwater policies affect the outcomes of these policies. Nevertheless, this study found that not restricting the autonomy of local governments, the approach taken in Texas, may reduce the volume of pollution caused by stormwater, which contributes to achieving the goals of stormwater management policies. This result is consistent with Oates and Portney's (2003) proposition that the problem of stormwater quality management measures should be dealt with according to the conditions of the local government. In other words, the local government must have sufficient independence to reconcile legislative requirements with local needs. On the other hand, this study contradicts Millimet's (2013) argument that the desired environmental results will not be achieved by decentralizing the implementation of the policy. On the contrary, this paper found that the increase in decentralization leads to a noticeable increase in the positive outcomes of the policy. On the other hand, an increase in centralization may lead to a noticeable decrease in the policy's desired results, as is the case with stormwater quality in California.

Interestingly, the current study found a difference between states with mixed institutional arrangements. For example, Virginia focuses on centralizing stormwater management standards, education requirements, and formal cooperative arrangements among the MS4 local governments. However, stormwater quality results in the state indicate that the problem is

increasing overall. In contrast, Minnesota has focused on centralizing the standards and the enforcement in comparison to the rest of the dimensions of the analysis. Nevertheless, Minnesota has seen a decrease in the pollution caused by stormwater. Therefore, it could be argued that the decentralizing of education and the cooperative relationships between the MS4 local governments may reduce pollution. This finding is compatible with Sigman's (2014) findings that decentralization does not increase the overall pollution. Finally, this study's results indicate that the disparity in the centralization and decentralization of the institutional arrangements adopted by states to implement the constitutional policies related to stormwater management will affect the outcomes of these policies, which aim at reducing the level of pollution resulting from stormwater.

Finally, it is worth noting that this study does not aim to establish a causal relationship between the institutional arrangements followed to implement stormwater management policies and stormwater quality. On the contrary, this study has explored the types of institutional arrangements and compared the outcomes of each arrangement according to the criteria published by each state. Statistical models were not built to extract performance results; rather, performance results were presented according to state reports. Further, this study suffers from some limitations with regard to comparing the results among the states, as each state follows an independent method for measuring and monitoring stormwater pollution. Another limitation is the degree of accuracy in measuring the levels of pollution caused by stormwater, which may limit the quality of the data published by the states. Finally, it should be noted that each state adopts its own definition of pollution levels (the level that it considers pollution). A certain level of one type of pollutant may be acceptable in one state, but the same level may not be accepted and may be considered pollution in another state. Despite these limits, the reports used for this

study have been viewed and approved by the Federal Environmental Protection Agency, making them generally comparable because they are subject to review and approval by a single source. In other words, if the reports did not reflect the state of water quality in the state, the federal agency would not accept them; hence, these reports are representative despite their differences.

3.6 Conclusion

This chapter investigates the impact of the states' institutional arrangements on environmental policy outputs by focusing on stormwater. To achieve the research objectives, two gaps were identified in the research literature: works that did not consider institutional arrangements via specialized studies (environmental or engineering) and those focused on a single study case without comparing it with several other case studies. In response to these gaps, this study has built on local public economies theory and the Race to Bottom literature to explore the impact of the institutional arrangements for implementing the MS4 permits used in each state on performance in reducing the level of pollution in stormwater, which would fulfill the goal of Clean Water Act, which aims to preserve the quality of water from pollution. By utilizing four case studies on California, Texas, Virginia, and Minnesota, this study has followed a qualitative approach to analyze the policy documents (MS4 permits) used for implementing stormwater management in these states. This study's qualitative approach has included review, evaluation, and comparison vis-a-vis the four case studies along the five dimensions of permit formalism, coercion, education, prioritization, and accommodation. In addition, the study used the periodic reports issued by the states to review the state of stormwater quality in these states.

The study found that states can be distributed across a spectrum of centralization and decentralization, along the five analytical dimensions. The study found that the outputs of stormwater management policies are affected by the institutional arrangements adopted by the

states, as evidenced by differences in stormwater quality in these states. This study will help public policymakers in the states compare the performance of their institutional arrangements with other institutional frameworks; in turn, this will help improve their choices in dealing with stormwater or other environmental policies. The paper results will also assist professionals in exploring the institutional arrangements in which they work within their states, which should help them increase their performance and improve their job outcomes. The study is aware that the use of case studies may result in findings with limited generalizability, and the stormwater quality differences may not be statistically significant or valid to establish causality. However, this exploratory study is based on the practices of the qualitative approach rooted in the literature on public administration and the self-reported status of stormwater quality by each state. Therefore, this study provides a valid overview of the impact of the policy institutional arrangements on the policy output.

Finally, future research on the impact of the policy institutional arrangements on the policy output should focus on other elements that may impact the selection of institutional arrangements for policy implementation. In addition, future research should examine a larger sample of states to improve the generalizability of the results. All in all, future research may find this study useful as a bridge connecting policy institutional arrangements with the policy outputs.

CHAPTER 4

ESSAY 2: LOCAL GOVERNMENTS' COOPERATION DECISIONS

4.1 Introduction

The dilemma of implementing policies in light of the horizontal fragmentation lies in the ability of local governments to work jointly to meet the legislative burdens associated with the process of implementing public policies imposed on them by higher governments. The institutional arrangements of the United States of America affect its local governments through regulations and standards that aim to resolve certain collective action problems in policy areas such as the environment. Implementing stormwater policies (MS4 permits) imposes requirements on the regulated local governments (RLGs) and does not provide funding to meet these requirements. In other words, local governments that are subjected to the MS4 permits must secure funds to comply with the MS4 requirements. However, the EPA and its counterparts in the States devote resources to ensure compliance or issue violation fines, as occurred in Texas (TCEQ, 2013). Moreover, compliance with the MS4 regulation requires cooperation between the RLGs, given that a drainage system may go through multiple cities. According to Minan (2005), the MS4 faces a legal dilemma because it requires a complete drainage system from the stormwater collection point to a discharge point; thus, the discharge may go through multiple cities, which raises multiple concerns about water pollution as well as about the economic cost associated with implementing the MS4 requirements. Since the implementation of the MS4 permits by local governments is a form of regulatory burden, the question then centers on the factors that affect the RLGs' cooperation choices through interlocal agreements for compliance, just as happens regarding service delivery. Specifically, this paper seeks to answer the following research question:

What are the factors that affect the regulated local governments' decisions to join an interlocal agreement (ILA)?

Thus, this paper investigates this missing link between the local governments that suffer from stormwater regulatory burdens (MS4) and the decision to enter an ILA. I investigate the factors that affect the RLGs' decisions by using a cross-sectional research design that captures the decision to join an ILA. A logistic regression model is used to analyze a case study consisting of 119 cities that are subjected to MS4 permits within the Dallas–Fort Worth (DFW) region in Texas. Since the decision of an RLG to join an ILA is rarely discussed or empirically examined, this article expands on the interlocal cooperation literature by examining the effects of geographic ties on RLGs' decision to join ILAs. In addition, this study expands the interlocal cooperation literature beyond a focus on public services provision and delivery to link cooperation with regulatory burdens. Studying the MS4 regulations also contributes to filling a significant gap in collective action policies literature related to stormwater problems. Finally, the study results help researchers and professionals identify the impact of geographical boundaries and other factors on their decisions to join ILAs.

4.2 Literature Review

4.2.1 Imposed Standards and Stormwater Regulatory Burdens

The regulations and standards imposed by higher authorities can become regulatory burdens on local governments. According to Esty (2016), compliance with the regulations and standards of the Department of Energy and Environmental Protection Agency and their counterparts in the States is associated with a cost paid either by individual users or by local entities. Similarly, Conlan, Riggle, and Schwartz (1995) argued that the Unfunded Mandate Reform Act of 1995 increased the already existing regulatory burdens on state and local governments by inserting enforceable duties on them without providing coverage of expenses. In

addition, Conlan, Riggle, and Schwartz (1995) stated that this unfunded mandate could cost state and local governments billions of dollars in compliance. The regulated local governments that the federal/state government requires to meet certain standards to comply with an unfunded mandate will then look for ways to reduce compliance costs.

Regulatory burdens and compliance are very important issues involving stormwater management. According to the USEPA Clean Watersheds Needs Survey (2016) stormwater management program, the states need approximately twenty billion dollars to meet their regulatory and compliance obligations. The Water Infrastructure Finance and Innovation Act (2014) has established the Water Infrastructure and Resiliency Finance Center (WIRF) to help local governments with financing mechanisms. The WIRF (n.d.) includes cooperation as one of its strategic goals to help local governments deal with water quality, including stormwater management. WIRF's efforts to enhance cooperation between local governments to reduce the regulatory burdens associated with implementing the MS4 and reduce the cost of compliance are rooted in the long history of the local government service delivery cooperation. However, the literature on local government cooperation for service delivery and the theoretical frameworks for this literature has for a long time overlooked the possibility of cooperation through ILAs to meet regulatory burdens and reduce the cost of compliance with these burdens. The following section discusses the literature on local government cooperation for service delivery and the gap in our knowledge regarding the role of ILAs in meeting regulatory burdens imposed by federal/state requirements.

4.2.2 Stormwater Management and Cooperation for Compliance

Cooperation among local governments has received much attention in the public administration literature. The interest in studying interlocal cooperation stems from the federal

nature of the U.S., which limits the ability of localities to effectively meet the demand for services; consequently, they must seek solutions to work collaboratively with other localities to achieve the benefit of cost reduction and effectively deliver or produce services (Shrestha & Feiock, 2011). Based on this logic, much literature has studied the factors that influence the decisions of localities, especially cities, to enter into agreements with other localities to provide or exchange services (Seyler, 1974; Thurmaier & Wood, 2002; Jung & Kim, 2009; McGuire & Silvia, 2010; Shrestha & Feiock, 2011; Andrew & Hawkins, 2013). Moreover, the interlocal agreements or government-to-government contracts are among the essential tools of cooperation between cities, which has attracted the attention of a large number of researchers (Thurmaier & Wood, 2002; Chen & Thurmaier, 2009; Kwon & Feiock, 2010; Shrestha & Feiock, 2011; Zeemering, 2012). A discussion of stormwater management regulatory burdens and cooperation for compliance requires a review of work on stormwater management within the local government cooperation literature as well as within the environmental management literature.

4.2.2.1 Stormwater Management in the Local Government Cooperation Literature

Under the institutional framework, ILAs are seen as voluntary and constituted by the self-interest of the contract members (Kwon & Feiock, 2010). Therefore, most ILA studies discuss the factors that influence the voluntary decisions of local governments to join such contracts. For example, Shrestha and Feiock (2011) studied the relationship between the transaction characteristics of the services and the tendency to enter into ILAs in 163 cities in the State of Georgia. Based on the 2002 ICMA survey, this work found a curvilinear relationship between the two variables. Another study conducted by Kwon and Feiock (2010) also focused on the self-interest and transaction aspects of ILAs using 2003 ICMA data from a survey of 3,215 municipality officers. In this study, Kwon and Feiock (2010) found differences between two

stages of making an ILA decision: consideration of joining an ILA and the implementation of the ILA.

Regarding consideration of joining an ILA, Kwon and Feiock (2010) tested three aspects: service demands, internal costs, and information costs; they found that service demands are the most important factor in this stage. At the implementation stage, they further investigated the negotiation/enforcement costs and the network relations, and they found that network relations are the most important factor for the success of an ILA. In contrast, Chen and Thurmaier (2009) studied the effect of perceived equitable sharing of costs in an ILA using a statewide survey of ILAs in Iowa covering the period from 1993 to 2004 and found that the success of ILAs is linked more to equitable sharing of benefits than to cost. The main finding in this area of research is that the desire to join an ILA stems from the internal need and not from impositions by higher authorities.

Part of the reason that the interlocal agreement literature does not focus on the burden of regulatory compliance is the lack of in-depth details regarding services. According to Qiao, Kristoffersson, and Randrup (2018), stormwater management suffers from the lack of specific inclusion within the institutional framework of local government services. In other words, stormwater management may sometimes be considered a technical problem that is not pertaining to administrators. It is treated as one of the services associated with governmental (bureaucratic) institutional work. Further, Dhakal and Chevalier (2016) stated that specialized engineers primarily carry out stormwater management under a unified public work system or in independent departments. In addition, stakeholders inside or outside the local government do not interfere in the work of professionals because they consider that this work is complicated and concerns specialists only (Dhakal & Chevalier, 2016). The perception of the specialization of

stormwater management has influenced the way this issue has been addressed in the literature on local cooperation. This perception of the specialization of stormwater management has led ILA researchers to examine public works incompletely or to not provide sufficient details about the stormwater management issue.

4.2.2.1.1 The Holistic View of Public Works ILAs

Taking the holistic view of public works, Morgan, Hirlinger, and England (1988) examined local governments' decisions regarding the external production of public works services by analyzing the decision of nearly sixty cities to contract with other local governments or external parties (profit or non-profit) to deliver services. Morgan, Hirlinger, and England (1988) found that the city location (within a Standard Metropolitan Area—MSA), tax rate limitations, community wealth (households with incomes of $30,000 or less), and organizational capacity (number of city employees) had a statistically positive significant impact on decisions regarding the external production of services. Similarly, Morgan and Hirlinger (1991) used International City Managers' Association data collected from more than 600 U.S. cities to test the impact of the city location (within an MSA) on local a government's decision to utilize intergovernmental service contracts to produce/deliver public works. Morgan and Hirlinger (1991) found that the city location, organizational capacity as measured by the size of the budget spent on employees, and the form of government had a statistically positive significant impact on cities' decisions to utilize ILAs for public works services. The holistic view of public works explains cities' ILA decisions in terms of the desire to reduce service costs, which would be visible only when a city has multiple service providers competing with each other by covering lowering the cost for the services. A city's location within a Standard Metropolitan Area facilitates the process of finding a sufficient number of suppliers for services. Consequently, the

city will choose an ILA that reduces the cost of producing and delivering the public works services. Therefore, the holistic view of public works articulates the decision to join an ILA in terms of the internal need for cost-saving by the local government.

4.2.2.1.2 Specific ILAs for Stormwater Management

Another stream within the ILA literature focuses on stormwater management issues but without regard to the issue of regulative burdens. For example, Wood (2006) examined nearly thirty intergovernmental service-delivery agreements among nearly fifty cities in the Kansas City region. Wood (2006) found that approximately seventy percent of the cities had set up ILAs to deliver stormwater services; on the other hand, nearly thirty percent of the cities were managing their stormwater internally (in in-house production). Wood (2006) characterized stormwater management as a system maintenance service. Thus, local governments were more likely to cooperate to deliver this service. This process is not visible to the citizens, and citizens have more narrow preferences regarding such services (Williams, 1971, as cited in Wood, 2006).

Similarly, Carr, Gerber, and Lupher (2007) studied cooperation behaviors between 460 Michigan local governments across 115 service categories using the 2005 Citizens Research Council of Michigan survey. Carr, Gerber, and Lupher (2007) found that stormwater management required medium capital intensiveness and high technical expertise, which led close to twenty-five percent of the study sample to conduct vertical (with the county government) ILAs to manage stormwater service as compared to approximately forty percent opting for in-house production a nearly ten percent carrying out production through horizontal agreements. Carr, Gerber, and Lupher (2007) explained that the decision to join a vertical or horizontal service delivery agreement lay in cities' financial ability to bear the burdens of capital-intensiveness and specialized expertise cost. Since stormwater management has a high demand

for technical expertise, local governments with low fiscal capacity will tend to cooperate vertically with governments.

In a more in-depth study of ten services from the same 2005 Citizens Research Council of Michigan survey, LeRoux and Carr (2007) specifically examined how stormwater management was impacted by economic factors (public works spending, intergovernmental revenues, per capita property, and per capita income) and local/regional characteristics (population, population change, population density, adjacent borders, population concentration in county), local demographic characteristics (population > 65, percentage population non-white), and Council of Governments (COG) membership. LeRoux and Carr (2007) found that economic factors, local demographic characteristics, and COG membership had no statistically significant impact on engagement in ILAs for stormwater management. However, LeRoux and Carr (2007) found that local/regional characteristics significantly impacted ILA engagement for stormwater management. According to LeRoux and Carr (2007), the adjacent borders variable had a statistically negative significant impact on ILA engagement for stormwater management, which contradicts the assumption of transaction cost theory that the presence of a large number of neighbors increases the likelihood of entering into cooperation.

The ILA literature focusing on stormwater management issues lacks sufficient attention to the question of joining an ILA to comply with regulatory burdens. One of the reasons for this lack of attention is a perception of the specialization required for stormwater management. Both Carr, Gerber, and Lupher (2007) and LeRoux and Carr (2007) used the same 2005 Citizens Research Council of Michigan survey, in which the participants indicated that stormwater management required high technical expertise. However, LeRoux and Carr (2007) stated that the survey was conducted by "the city administrator or mayor, village manager or president, or

township supervisor" (p. 349). In other words, all the participants in the study were not specialists but rather provided their answers according to preconceived notions about the specialization of stormwater management. This lack of attention to stormwater management regulatory burden has created a mismatch between the explanatory theory (transaction cost) used by the ILA literature and the practice (joining an ILA for managing stormwater).

4.2.2.2 Stormwater Management within the Environmental Management Literature

Environmental professionals may consider that compliance with regulatory burdens would limit their intentions to cooperate with other local governments. For example, Youm (2014) studied the impact of regulative burdens imposed by the federal governments (and states) on 315 local governments' decisions to enter into voluntary cooperative relationships to implement the Energy Efficiency and Conservation Block Grant program. Youm (2014) found that the compliance burden enforced by the federal government on local governments had a statistically negative significant impact on the local governments' decisions to enter into voluntary cooperative relationships to implement the program. In other words, the results indicated that the presence of legislative burdens reduced the desire to enter into cooperative relations. However, the cooperation between local governments in meeting stormwater regulatory burdens may have a positive impact. For example, Hoornbeek, Beechey, and Pascarella (2016) studied the effectiveness and efficiency of cooperation in eleven cities in Ohio to meet stormwater regulation (MS4) requirements. Hoornbeek, Beechey, and Pascarella (2016) reported that the participants (project managers in each city) in the study case stated that the cooperation contributed to meeting the legislative requirements in a short period of time in addition to providing an overall cost saving for all participants totaling nearly half a million dollars. Thus, it can be said that there is a discrepancy between findings of the environmental

management literature on the issue of cooperation and compliance with regulatory burdens.

Therefore, the gap in interlocal cooperation and environmental management literature has two aspects. The first aspect is related to the lack of attention to joining an ILA in order to comply with regulatory burdens on the part of both the holistic view of public works ILA studies and the specific focus on stormwater management ILAs studies, which leads to a mismatch between the explanatory theory (transaction cost theory) used by the ILA literature and the practice (ILA for managing stormwater). As a result of not including regulatory burdens as one reason for organizations to join ILAs, the current ILA literature does not discuss the factors influencing the RLGs' decisions to join ILAs. The other aspect relates to cooperation and compliance with regulative burdens in the environmental management literature is that there is a disagreement between this type of literature. Therefore, our study empirically examines factors affecting RLGs' decisions to join ILAs, which will expand the interlocal cooperation and ILA literature beyond public service provision/delivery to create a link with regulatory burdens as a reason for joining an ILA. In other words, the current study explores the decisions of cities subject to regulatory burdens with respect to entering ILAs.

4.3 The Proposed Theoretical Framework

The transaction costs approach has been used to explain government decisions regarding the provision of services and their choices among the available alternatives to solve collective action problems (Feiock, 2013). According to Williamson (1981), entering into contractual relationships involves many complications associated with writing and enforcing contracts in light of the desire of the contracting parties to reduce their costs and achieve their interests. In other words, decisions regarding entering into contractual relationships include an additional cost that affects the total value of the contract, which is reflected in the cost of obtaining information

on preparing the contract, as well as linked to the monitoring cost associated with ensuring the enforcement of the contracting process. In addition, Williamson (1981) argued that the decision of whether to produce or purchase services through external contracting is related to the management of the cost of contracting and limiting factors that may increase the transaction cost, as a result of the lack of information and uncertainty. The information threat stems from the fact that the contracting parties will enter into a principal (contracting organization)-agent (vendor) relationship that is threatened by information asymmetry between the two; thus, the contracting parties need to research and negotiate the real price of the service, a process which increases the cost of contracting (Williamson, 1981). On the other hand, the uncertainty threat stems from the fact that the contract parties cannot determine all the circumstances surrounding the enforcement of the contract; thus, vendors or contractors may engage in opportunistic activities or behaviors, which would require directing sources to monitor the enforcement of the contracts, thus increasing the total cost of the contracts (Williamson, 1981). Therefore, transaction costs affect the cost savings associated with the process of providing services through outsourcing.

During the nineties, there was great pressure on the government for New Public Management reforms to reduce costs by providing services through external contracting (Milward & Editor, 1996). In light of this pressure to cut costs, governments' decisions regarding the internal provision of services or contracting them out (while preserving the ownership and liability associated with the service) were linked to a number of transaction cost risk factors, including service-specific characteristics, the degree of competition, and goal incongruence of the contracting parties (Brown & Potoski, 2003). Regarding the service-specific characteristics of the transaction cost risks factors, Brown and Potoski (2003) distinguished between two characteristics that could influence governments' decision to produce services: service asset

specificity and service measurability. Service asset specificity is concerned with the degree to which specialized investments that cannot be transferred to other uses, which would create a monopoly for the first contract vendors due to the high start-up cost; thus, governments will prefer to provide these services internally (Brown & Potoski, 2003). By contrast, service measurability is concerned with measuring service performance, which will create an opportunity for the emergence of opportunistic behavior of the vendor if the service is difficult to measure (Brown & Potoski, 2003). In addition, the degree of competition between the service vendors represents another transaction cost risk factor. According to Brown and Potoski (2003), the contracting process becomes more efficient if there are a sufficient number of competing service providers because there being a sufficient number of competitors contributes to the revealing of information about the real price of the service in addition to the reduction of the cost of monitoring, as the service providers will be under threat of losing contracts in favor of other providers in the next contracting round if they do not adhere to the quality of implementation. Finally, the goal incongruence, as a transaction costs risks factor, is related to reducing the quality of contract implementation in the presence of information asymmetry dilemmas between the principal (contracting organization) and the agent (vendor); thus, governments will tend in favor of joint contracting with other governments if the service is characterized as highly asset-specific or difficult to measure or if there is a limited (e.g., in non-competitive marketplaces) number of service providers (Brown & Potoski, 2003). Therefore, governments that aspire to save costs through contracting out service providers must consider factors that threaten to increase their transaction costs.

With regard to stormwater management, the transaction cost approach has been utilized to explain government decision management internally, joint vertical agreement, or horizontal

agreement (Morgan, Hirlinger, & England, 1988; Morgan & Hirlinger, 1991; Wood, 2006; Carr, Gerber, & Lupher, 2007; LeRoux & Carr, 2007). However, the results of these studies differ regarding the transaction cost risk factors that impact the local government decisions on stormwater management. For example, in relation to service-specific characteristics and goal incongruence, both Wood (2006) and Carr, Gerber, and Lupher (2007) found that stormwater management is characterized as highly asset-specific and is not difficult to measure, which has led the local government to contract only with other governments or perform the functions internally. On the other hand, we find a lack of agreement about the impact of geographic location on the local governments' decisions on stormwater management. Both Morgan, Hirlinger, and England (1988) and Morgan and Hirlinger (1991) related the geographic location of the local government to its ability to have a sufficient number of suppliers—that is, the existence of a competitive market for the service; specifically, the location of local governments within a Standard Metropolitan Area increases the opportunities for contracting out to provide stormwater management service. On the other hand, LeRoux and Carr (2007) found that an increase in the number of neighbors negatively affected decisions to join ILAs related to stormwater management, which contradicts assumptions regarding the impact of competition on transaction costs. Therefore, it is evident that decisions on stormwater management may be limited depending on whether the impact of the geographical location of the local government is positive or negative in relation to joining into contractual relationships for the implementation of services.

Regarding the question of joining ILAs to comply with the stormwater regulatory burden, I argue that the geographical location of the local government has an impact on its decision to join contractual relations for the implementation of stormwater regulations. According to

Bowman and Kearney (2012), local governments have insufficient substantive authority to effectively comply with the devalued federal and state governments' program implementation responsibilities. The insufficient substantive authority in this regard concerns regulating or financing the implementation of the program (Bowman & Kearney, 2012). In other words, the regulatory burdens associated with the devalued policy implementation create legal responsibility for local governments without providing tools that harmonize the process of fulfilling this responsibility. Within the stormwater management regulative burdens, local governments face legal liability for implementing the imposed regulations even though stormwater can come from neighboring cities or sources not covered by the legislation (Dhakal & Chevalier, 2016). In addition, the decision to fund the implementation process, either through stormwater service fees or through general tax revenues, is considered to be of high political cost, as it is subject to the financing regulations followed in each state as well as to citizens inputs (Grigg, 2013). Since local governments are legally liable for implementing stormwater policies and are subject to a high political cost financing mechanism, they will more readily engage in cooperative behaviors that do not risk such liability.

The transaction cost assumption regarding the positive impact of having access to a pool of competing service suppliers upon joining contractual relations offers a suitable lens for interpreting decisions to engage in cooperation between local governments to meet the regulatory burden imposed by the implementation of stormwater policies. According to Dhakal and Chevalier (2016), the sharing of hydrological boundaries necessitates cooperatively work in a hydrological unit to avoid negative externalities that may affect all members within this unit. Similarly, geographical position or geographical ties play a central role in local governments' decisions to enter into a cooperative relationship. According to Post (2002), "local governments

generally cooperate with geographically proximate governments" (p. 43). In other words, neighboring local governments are likely to participate more in cooperative activities. In addition, Feiock (2007) argues that "[n]eighbors have incentives to cooperate based on the technical costs of sharing services" (p. 54). In other words, sharing geographical boundaries reduces the cost of service negotiating and delivery. Since complying with the regulatory requirements of stormwater management policies is a legal liability for regulated local governments, they will seek to reduce the cost of compliance by joint contracting with neighboring governments with whom they are sharing geographical boundaries; thus, I hypothesize the following:

> *H_1: An increase in the number of neighboring RLGs is associated with an increase in the likelihood of an RLG's decision to join an ILA, all else equal.*

In addition, there is another factor that influences local government decisions regarding joining ILAs to comply with the stormwater regulatory burden: population density. The dispersion of population or population density increases the cost of providing public services (Ladd, 1992). According to Ladd (1992), increases in population density require the concentration of services (police, garbage collection, traffic lights, etc.) in a specific area, while the cost is divided among the entire population, which creates diseconomies for the rest of the residents; thus, the local government will seek to reduce costs by searching for cooperation opportunities. Nevertheless, in the area of stormwater management, population density is one of the reasons for the problem (Baker, 2009b). When people cluster in cities, there will be an increase in urban areas within those cities; thus, the risks associated with stormwater management will increase. Leroux and Carr (2007) found that population density had a significant statistical effect on the decision to cooperate in stormwater management, which creates the connection between population density and stormwater management. Therefore,

regarding local government decisions to join ILAs in order to comply with the stormwater regulatory burden, I hypothesize the following:

> *H_2: An increase in the population density is associated with an increase in the likelihood of the RLGs' decisions to join ILAs, all else equal.*

Finally, the following section provides details about the case study, along with the research data and methodology.

4.4 Research Design

To test our research hypotheses, we conducted a study with a cross-sectional design to analyze a case study, and our unit of analysis was the MS4 city. Our case study included all the cities subjected to MS4 permits within the Dallas–Fort Worth (DFW) region in Texas. According to the TCEQ (n.d.), there are 119 cities subjected to MS4 permits, out of 224 cities in the state, in the DFW region. Moreover, seven cities are MS4 Phase I, representing half of the Phase I cities in Texas, and 113 cities are MS4 Phase II, representing about one-third of the MS4 Phase II cities in the state. Besides representing a sufficient number of RLGs, the cities within the DFW region feature disparities in size and nature in their populations and economic activity. Moreover, the DFW region has diverse institutional arrangements, which include the North Central Texas Council of Governments (NCTCOG)—the "second-largest metropolitan planning area in the nation" (NCTCOG, 2017). More importantly, the NCTCOG is the only regional organization in the state of Texas that provides a stormwater management program.

The NCTCOG stormwater management program is managed by the Regional Stormwater Management Coordinating Council (RSWMCC). The RSWMCC is responsible for forming an annual plan to address "state and federal stormwater quality regulations" (NCTCOG, n.d.). Moreover, the RSWMCC offers an annual contract to help the MS4 cities to comply with the MS4 permit requirements. Under this contract, the Phase I cities are responsible for the regional

cooperative monitoring of the TCEQ permit (NCTCOG, n.d.). With this diversity among cities and the availability of many institutional arrangements, the DFW region is well-suited for this study.

Table 4.1: Description of Measurements and Data Sources

Variables	Measurements	Data Sources
Dependent Variable		
MS4 ILA	Codded 1 if the MS4 city was a member of the MS4 ILA in 2017, 0 otherwise.	NCTCOG
Independent Variable		
Neighboring Number	Number of neighboring cities.	NCTCOG
Population Density	Persons per square mile in 2016	U.S. Census Bureau
Control Variables		
Log Community wealth	The natural log of per capita income in 2016	U.S. Census Bureau
Public Works Spending	Percent of spending on public works from the total budget in 2016	Cities' websites
Stormwater Fee	A dichotomous variable coded one if the local government in 2016 had a stormwater fee or zero otherwise	Cities' websites
Government Type	A dichotomous variable coded one if the local government in 2016 had Council-Manager form of government or zero otherwise	Cities' websites
Older Population	Percent of residents who were 65 old or older within the population in 2016	U.S. Census Bureau

In sum, the data used in this study were collected from two sources, the TCEQ website, and NCTCOG records. First, we reviewed the TCEQ website to identify all MS4 cities in the DFW region and their types. Second, NCTCOG records were reviewed, and the data on MS4 cities that were members of NCTCOG was collected. NCTCOG records also include data on the members of their 2017 MS4 ILA. Therefore, our final sample included all the 119 MS4 cities in

the DFW region, 97 of these cities being NCTCOG members, and the study period was the year 2017.

4.4.1 The Dependent Variable

Following Morgan and Hirlinger (1991), the dependent variable was joining the *MS4 ILA.* It was measured by one dummy variable (coded One if MS4 city was a member of the MS4 ILA, zero otherwise). This measure was consistent with the nature of the phenomenon under study, as there were no inconsistent demands for membership or other attributes of membership. The cities either decided to join the ILA or not to join. Therefore, this measure captured the MS4 city decision to join the ILA.

4.4.2 Independent Variables

The first independent variable *is the total number of neighboring cities*, operationalized as having shared boundaries with MS4. In addition, we measured the shared boundaries according to the administrative boundaries provided by the Texas Department of Transportation (n.d.), which is a corresponding measurement of the geographical location of the cities with stormwater literature (Morgan & Hirlinger, 1991; LeRoux & Carr, 2007). With data on geographical boundaries, it was easy to build a measurement based on the number of neighbors. The number of miles that separate a city from its central urban city would not have added any value to this study; thus, the employed measure of the geographical location served the study's objectives. In addition, LeRoux and Carr (2007) used a similar method of measuring the number of neighboring cities; thus, this study's operationalization of the total number of neighboring cities was in line with the literature.

The second control variable is *Population Density*, which measured the number of persons per square mile in a unit in 2016. This measurement is consistent with local agreement

literature exploring the effect of this factor upon entry into cooperative relations among local governments (Ladd, 1992; Leroux & Carr, 2007; Kwon, & Feiock, 2010; Andrew, Short, Jung, & Arlikatti, 2015). As stated previously, the cost of providing public service would be expected to increase with increases in population density. Therefore, the population density variable was used to test my third hypothesis.

4.4.3 Control Variables

The first control variable is the *Community Wealth*, which was measured by per capita income in 2016. The variable could affect the city's ability to join a regional organization or enter an ILA (Morgan & Hirlinger, 1991; Leroux & Carr, 2007). Specifically, Morgan and Hirlinger (1991) found that there was a negative nonlinear relationship between community wealth and the decision of the local government to join an ILA; thus, as the community wealth increases, the likelihood of joining an ILA is expected to decrease, but after subsequent increases in community wealth, governments will seek to join an ILA. In other words, wealthy communities will be more willing to join an ILA. Similarly, Leroux and Carr (2007) found similar findings regarding the nonlinear relationship between community wealth and the decision of the local government to join the ILA. Leroux and Carr (2007) stated that "[t]his tendency toward cooperation disappears as community wealth increases but reemerges among very wealthy communities" (p. 352); thus, the nonlinear relationship was conformed. However, after conducting a meta-regression analysis based on approximately 50 empirical articles about cooperation, Bel and Warner (2016) concluded that the community wealth effect is not fully known. Some studies have found that wealthy communities will not seek cooperation since they do not experience economic pressure. Given the variations in the effect of this factor, this study will use the log of per capita income in 2016 to ensure that the community wealth effect is not

affected by the variation of the per capita income within the data.

The second control variable is *Public Works Spending*, measured by the percent of spending on public works from the total budget in 2016. According to Morgan and Hirlinger (1991), the amount of spending on public works indicates the extent of financial pressure on the local government, which can lead them to adopt alternatives to reduce public works service costs (stormwater management often falls under the public works department). Nevertheless, Leroux and Carr (2007) pointed out that spending on public works may not be of direct benefit to political leaders in local governments because it is less visible to the population as compared to other services that they can claim credit for, such as public safety; thus, political leaders in local government will look for ways to redirect the resources from public works to other more visible services. In other words, political leaders are motivated to reduce the cost of public works services in comparison to other services. Therefore, this study includes a control variable that measures the impact of the volume of spending on public works on the decision of local governments to join an interlocal agreement for stormwater management.

The third control variable is whether there is a *Stormwater Fee* assessed by the local government, measured by one dichotomous variable coded one if the local government in 2016 had a stormwater fee or zero otherwise. According to Grigg (2013), stormwater management has become complicated because it includes a number of services, including "storm drainage, water quality, mitigation of land-use impacts, floodplain management, and open space amenities" (p. 6). In addition, Grigg (2013) points out that the imposed unfunded stormwater mandate has moved stormwater management from being a pure public good (non-excludable and non-rivalrous, e.g., rainwater collecting and draining) to become a public good utility in which customers are charged to access the stormwater services. However, Grigg (2013) stated that the

practice of charging a fee for stormwater faces questions about this utility's measurability and the rationales for the charging schemes; thus, for this study, local governments were divided in the area of financing stormwater management into two models: the first engaged in financing through taxes, and the other engaged in financing through service fees. Campbell (2020) identified and recoded all information about stormwater utility implementation in local governments since the Western Kentucky University Stormwater Utility Survey 2010. It was found that there were more than 1,800 cities imposing stormwater service charges in 41 states. Further, Campbell (2020) found that Texas had more than 120 cities that imposed stormwater utility fees. According to Zhao, Fonseca, and Zeerak (2019), there is no agreement on the extent to which stormwater utility fees can meet all the financial burdens associated with implementing stormwater quality mandates. On the one hand, the fees may be sufficient to meet the financial need and thus to meet the legislative burdens (Zhao, Fonseca, & Zeerak, 2019). On the other hand, there are many legal restrictions on the ability of local governments to impose such fees (Campbell, 2020). Therefore, the necessity of having a stormwater fee may dissuade local governments from entering into a local agreement to meet legislative burdens or contribute to funding to enter into a local agreement to meet those burdens; thus, the Stormwater Fee variable controls for the potential effect of stormwater utility fees.

The fourth control variable is the *Government Type*, measured by one dummy variable coded one if the local government in 2016 had a council-manager form of government or zero otherwise. According to Andrew (2009), the form of government as a factor that influences the decision of local governments regarding inter-jurisdictional interaction has received "compelling arguments" in that professionals (as compared to elected leaders) are more motivated to enter into such relationships because they aspire to enhance their career gains in the long term as

argued by Stein (1990 as cited in Andrew, 2009). Such arguments regarding the professional's motivation to enter into inter-jurisdictional interactions were evidenced by literature such as (LeRoux 2006, as cited in Andrew, 2009), Feiock (2007, as cited in Andrew, 2009), and Krueger and McGuire (2005). However, another stream of literature argues that the influence of the type of local government leadership on the decision to enter into cooperative relationships is related to the type of service for which the mayor-council form of government will seek cooperative relationships in visible political functions like economic development, and council-manager form of government will seek cooperative relationships in visible functions that are routine services (Kwon, & Feiock, 2010; Shrestha, & Feiock, 2011; Hawkins, 2017). Given that stormwater management and the meeting of legislative burdens are less attractive to the attention of politicians (Zhao, Fonseca, & Zeerak, 2019), it can be said that stormwater management may fall under the category of routine services. Therefore, this study controls for the impact of the form of government on the decisions of local governments to enter into an ILA to meet the legislative burdens of stormwater management.

The fifth control variable is related to social homogeneity. According to Morgan and Hirlinger (1991), the vulnerable groups in society are the ones most accustomed to the services provided by local governments; thus, decisions to reduce the cost of services provided by these governments may be affected by the size of this population group, which include the *Older Population*. Moreover, members of the senior population (age 65+) are more active in politics than younger individuals and may have a role in influencing local governments' decisions to enter into cooperative relationships (Morgan & Hirlinger, 1991); thus, the final control variable is the size of the Older Population, which is measured by the percentage of residents who were of age 65 or older within the population in 2016. LeRoux, Brandenburger, and Pandey (2010) found

that the senior population had a significant statistical effect on local governments' decisions to enter into ILAs; therefore, I control for this variable in this study.

Besides the controlling variables of this study, which represent the greatest potential impacts on the study issue (meeting the stormwater management requirements), I did not control for numerous variables that may impact cooperation decisions among local governments. These variables would include organizational factors or service level transaction costs. Bel and Warner (2016) found that such variables were statistically significant only approximately 40% of the time in the studies that they reviewed. Therefore, including more control variables would not have been beneficial for this study.

4.4.4 Data Analysis

Since this study uses a binary response measurement for our dependent variable, logistic regression is used to analyze our data. According to Agresti (2007), logistic regression is used to analyze a nonlinear relationship that takes the S-shaped curves function, which is used to estimate probabilities of success or failure of outcomes within a binomial distribution. In other words, it shows the odds of one event occurring against the other. The logistic regression predicts the logarithm of the odds scale, which often transfers to odds ratios or predicted probabilities, increases the dependent variable every for a one-unit increase in the independent variable (Agresti, 2007). Therefore, the mathematical expression for this study's logistic regression is as follows:

$$E(\hat{Y} = 1|X_i) = a + \beta_1(\text{Neighboring Number}) + \beta_2(\text{Population Density}) + \beta_3(\text{Log Community wealth}) + \beta_4(\text{Public Works Spending}) + \beta_5(\text{Stormwater Fee}) + \beta_6(\text{Government Type}) + \beta_7(\text{Older Population}) + e$$

According to Frankfort-Nachmias and Nachmias (2007), a cross-sectional design increases a

study's external validity because it does not require random assignment for the individuals who are participating in the study. In addition, this design limits the internal validity of the study. Therefore, there are a high chance of heteroscedasticity (having an equal residual variance at each level of the predictor) issues, which may not be a problem with binary logistic regression; however, residuals should be standardized in logistic regression (Menard, 2010).

Multicollinearity (a high correlation between independent variables) is also a problem that affects the hypotheses' test results (Midi, Sarkar, & Rana, 2010). As the correlation between the independent variables increases, it becomes difficult to differentiate the individual effects of the independent variables on the dependent variable (Menard, 2010). Therefore, I used a correlation matrix to test for any potential multicollinearity among my independent variables, as shown in Table 4.2.

4.5 Results and Discussion

4.5.1 Results

Based on the results of the descriptive analysis presented in Table 4.2, it can be seen that there is some dispersion with the data. For example, the number of neighboring cities varies between 0 to 25 cities with a mean for this variable of 3.58; thus, on average, each city within the sample had about four neighboring cities. This discrepancy can be attributed to the fact that suburban cities are spread among the region's major cities, such as Dallas and Fort Worth. Concerning population density, we found that the average was about 1,888 people per square mile. The lower density was recorded at 109.20 people per square mile, and the highest density was recorded at 7183.10 people per square mile. According to the United States Census Bureau (2015), the average population density at the United States level is 90 people per square mile, but this varies according to the urbanization progress in different regions: the greater the urban level,

the greater the population density.

Table 4.2: Variables' Descriptive Statistics (*N* = 119)

Variable	Mean	SD	Min Value	Max Value
MS4 ILA	.43	.50	0	1
Neighboring Number	3.58	3.33	0	26
Population Density	1887.98	1380.84	109.20	7183.10
Community Wealth	38094.29	22244.81	2345	146644
Public Works Spending	27.10	14.07	2.54	96.46
Stormwater Fee (Having a fee=1)>a	.43	.50	0	1
Government Type (Council – Manager=1)>b	.77	.42	0	1
Older Population (65+ old)	11.77	4.97	4.20	33.40

[a]<Not having a fee> is the reference group. [b]<Mayor- Council> is the reference group.

The average per capita income for people within the cities sampled was about thirty-eight thousand dollars, which was higher than the thirty-one thousand dollars average per capita income for people within the state of Texas (United States Census Bureau, 2019). Regarding spending on public works, the average spending of about 27.10% of the total budget was not surprising because public works may account for 25% of local government expenditures (Urban Institute, n.d). Therefore, the descriptive analysis results indicated that the study sample might include some dispersion, supporting the decision to take the natural log for the *Community wealth* variable. Thus, the Robust function in Stata was used to control for any potential heteroscedasticity issues.

The correlation matrix in Table 4.3 makes it clear that multicollinearity does not exist since the Pearson correlations of all variables range from .429 to -.002, which indicates that there is no high correlation between the study's independent variables. In addition, the Neighboring Number, Population Density, Log Community wealth, Stormwater Fee, Government Type, and Older Population variables are positively correlated with the dependent variable.

Table 4.3: The Correlation Matrix (*N* = 119)

Variable	MS4 ILA	Neighboring Number	Population Density	Log Community wealth	Log Public Works Spending	Stormwater Fee	Government Type	Older Population
MS4 ILA	1							
Neighboring Number	.397	1						
Population Density	.364	.225	1					
Community wealth (Log transformed)	.147	.055	-.136	1				
Public Works Spending (Log transformed)	.002	-.100	-.122	.035	1			
Stormwater Fee (Having a fee=1)>[a]	.382	.361	.429	.043	-.015	1		
Government Type (Council – Manager =1)>[b]	.429	.270	.189	.101	.132	.388	1	
Older Population (65+ old)	-.052	-.184	-.156	.238	-.002	-.095	-.042	1

[a]<Not having a fee> is the reference group. [b]<Mayor- Council> is the reference group.

However, the Older Population variable is negatively correlated, which is in line with the expectation for this variable. Although Public Works Spending is positively correlated with the dependent variable, the correlation is close to zero (.002), indicating no correlation between the Public Works Spending variable and this study's dependent variable. The Hosmer-Lemeshow test was used to determine the goodness of fit of the study model. According to Hosmer Jr., Lemeshow, and Sturdivant (2013), the Hosmer-Lemeshow test is used to test how the observed outcome rates would match the expected outcome rates in population subgroups (usually ten groups). The Hosmer-Lemeshow test was 5.27 (df= 8, p= .70), which indicates that the model seems to fit the data well since the expected observed frequencies are above five. The model correctly predicts the data 77.31% compared to not using the model. In addition, the overall model chi-square is statistically significant (df= 7, p< .001); thus, it can be concluded that the logistic regression model fits the study data.

The logistic regression analysis was conducted to investigate the impact of the number of neighboring cities (M = 3.58, SD = 3.328), the population density (M = 1887.98, SD = 1380.84), the community wealth (M = 38094.29, SD = 22244.81), the public works spending (M = 27.10, SD = 14.07), the stormwater fee (M = .43, SD = .50), the government type (M = .77, SD = .42), and the older population (M = 11.77, SD = 4.97) on the decision of the local government to enter into an inter-local agreement—MS4 ILA (M = .43, SD = .50) to meet the legislative burdens related to stormwater management. Table 5.4 reports the results of the logistic regression, which indicate that there were some significant associations between the number of neighboring cities, the population density, the community wealth, the public works spending, the stormwater fee, the government type, the percentage of the older population, and the decision of the MS4 city to enter into MS4 ILA ($\chi 2(7) = 34.30$, $p < .001$). All predictor variables were tested a priori to

verify that there was no violation of the assumption of the linearity of the logit. The number of neighboring cities, the population density, and the government type in the logistic regression analysis were statistically significant predictors of the decision of the MS4 city to enter into an MS4 ILA. The unstandardized Beta weight for the Constant was B= -11.402, SE= 5.006, p < .05. The unstandardized Beta weight for the number of neighboring cities variable: *B*= .382, SE= .141, $p < 0.05$. The estimated odds ratio favorite increase of nearly 46.5% [*Exp (B)*= 1.465, 95% CI (.105, .660)] for MS4 ILA every one city increases of the number of neighboring cities. The unstandardized Beta weight for the population density variable: *B*= .001, SE= .001, $p < 0.05$. The estimated odds ratio favorite increase of nearly 0.1% [*Exp (B)*= 1.001, 95% CI (.001, .008)] for MS4 ILA every one person per square mile increases of population density. The unstandardized Beta weight for the government type cities variable; *B*= 2.580, SE= 1.166, $p < 0.05$. The estimated odds ratio favorite increases by nearly 1230.2% [*Exp (B)*= 13.302, 95% CI (.297, 4.878)] for MS4 ILA transition from a mayor-council system to a council-manager system.

Table 4.4: Logistic Regressions Results (*N* = 119)

Variable	MS4 ILA	
	B (SE)	Odds Ratio (% Change)
Neighboring Number	.382** (.141)	1.465 (46.5%)
Population Density	.001** (.001)	1.001 (0.1%)
Community wealth (Log transformed)	1.354 (1.159)	3.875 (287.4%)
Public Works Spending (Log transformed)	.003 (.016)	1.003 (0.3%)
Stormwater Fee (Having a fee=1)>[a]	.123 (.526)	1.130 (13.1%)
Government Type (Council – Manager =1)>[b]	2.580* (1.168)	13.302 (1230.2%)
Older Population (65+ old)	.024 (.048)	1.025 (2.5%)

Variable	MS4 ILA	
	B (SE)	Odds Ratio (% Change)
Constant	-11.402* (5.006)	
Pseudo R^2	0.333	
-2 Log Likelihood	-54.187	
Model X^2	34.30^{***}	
Hosmer-Lemeshow X^2 test	5.47	
% correctly predicted with the model	77.31	
Model Degrees of Freedom	7	

Note: B (SE) = unstandardized estimate of the logistic regression coefficient (and its standard error). [a]<Not having a fee> is the reference group. [b]<Mayor- Council> is the reference group. $^{***}p \leq 0.001$, $^{**}p \leq 0.01$, $^{*}p \leq 0.05$ (two-tailed tests)

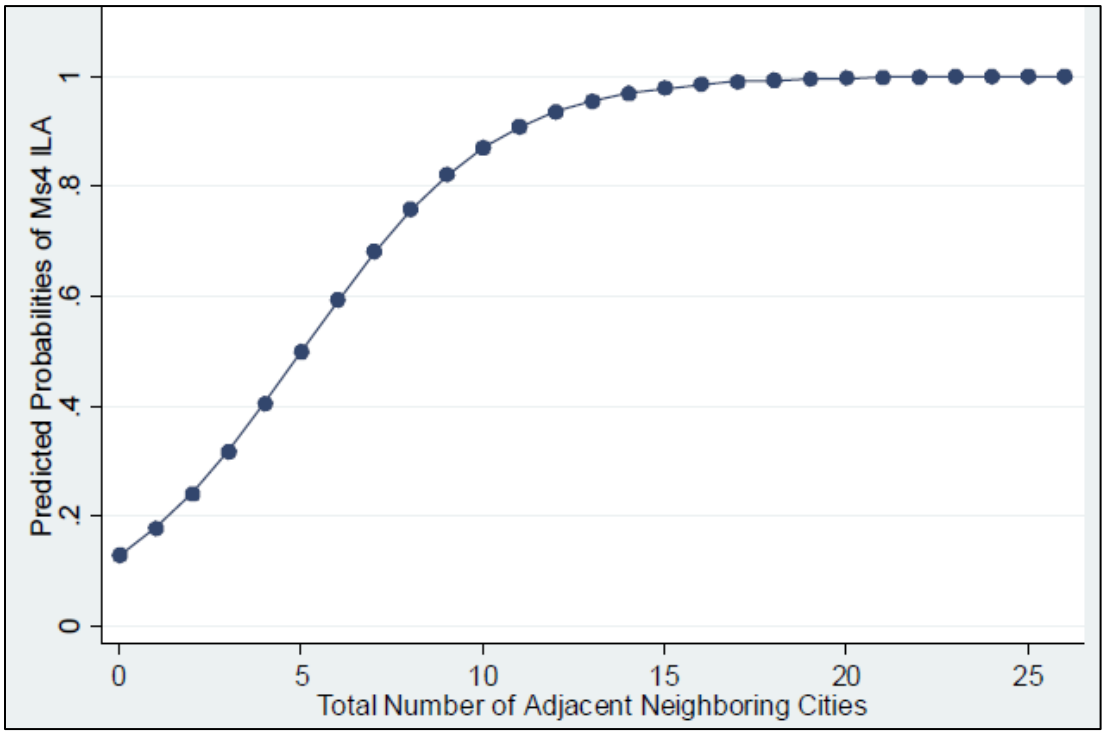
4.5.2 Discussion

The logistic regression analysis results supported both of this study's hypotheses. The analysis results indicated statistically significant evidence supporting the hypothesis regarding the impact of the number of neighboring cities on the MS4 cities' decisions to join inter-local agreements to meet the legislative burdens associated with stormwater management legislation. As shown in Figure 4.1, the average predicted probability of joining an MS4 ILA by an MS4 city increased as neighboring cities increased. These results are consistent with the transaction cost argument regarding the positive impact of having a supply of alternative providers on local governments' decisions to enter into inter-local agreements to provide the service (Brown & Potoski, 2003). Similarly, this study's finding is consistent with Morgan and Hirlinger's (1991) finding that having access to alternative providers increases the likelihood of joining inter-local agreements.

On the other hand, the result of this study is at odds with Post's (2002) conclusion that alternative service providers may not be important, as this study demonstrates it is an important predictor variable. The results of this study indicate that having access to alternative providers

increases the likelihood of joining the inter-local agreements, which conflicts with the results of LeRoux and Carr (2007), who found that having access to alternative providers decreases the likelihood of joining inter-local agreements for stormwater management. The change in the direction of the impact of this variable can be attributed to the fact that stormwater management legislation has expanded during the past years, which may have created an urgent need to meet legislative burdens through local agreements. Therefore, the study results support the hypothesis that an increase in the number of neighboring cities increases the likelihood of entering into cooperative relationships to meet the requirements of the legislative burdens of stormwater management.

Figure 4.1: Predicted Probabilities of Joining MS4 ILA by the Total Number of Neighboring Cities



Regarding population density, the results of this study indicate that there is statistically significant evidence supporting the hypothesis about the impact of population density on an MS4 city's decision to join an inter-local agreement to meet the legislative burdens associated with

stormwater management legislation. As shown in Figure 4.2, the average predicted probability of an MS4 city's joining MS4 ILA increases as the population density increases. While LeRoux and Carr (2007) stated that population density is related to inter-local cooperation on water and sewer utilities, it was found in the current study to be a statistically significant predictor of inter-local cooperation on stormwater management. Similarly, this study found that population density had a statistically positive significant impact on an MS4 city's decision to join an inter-local agreement to meet the legislative burdens associated with stormwater management legislation. This result can be attributed to the fact that population density reflects one of the sources of the stormwater pollution problem; thus, the greater the population density, the more urban construction, which means the city would be more subjected to the implementation of stormwater legislation by local governments. Therefore, the study results support the hypothesis that an increase in the population density increases the likelihood of entering into cooperative relationships to meet the requirements of the legislative burdens of stormwater management.

Figure 4.2: Predicted Probabilities of Joining MS4 ILA by Population Density

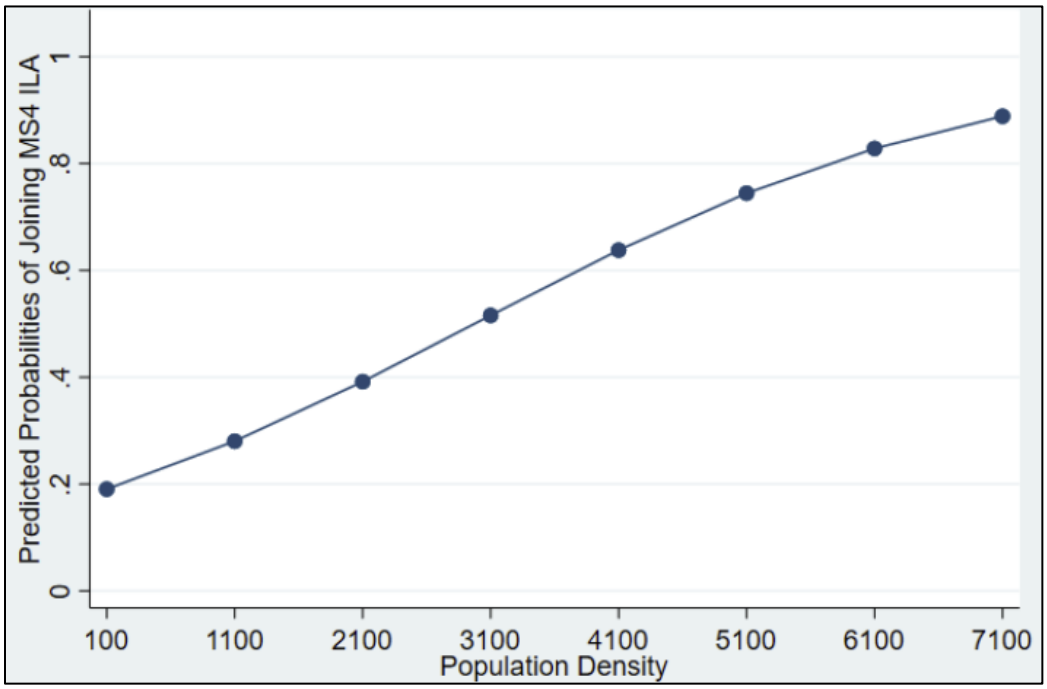
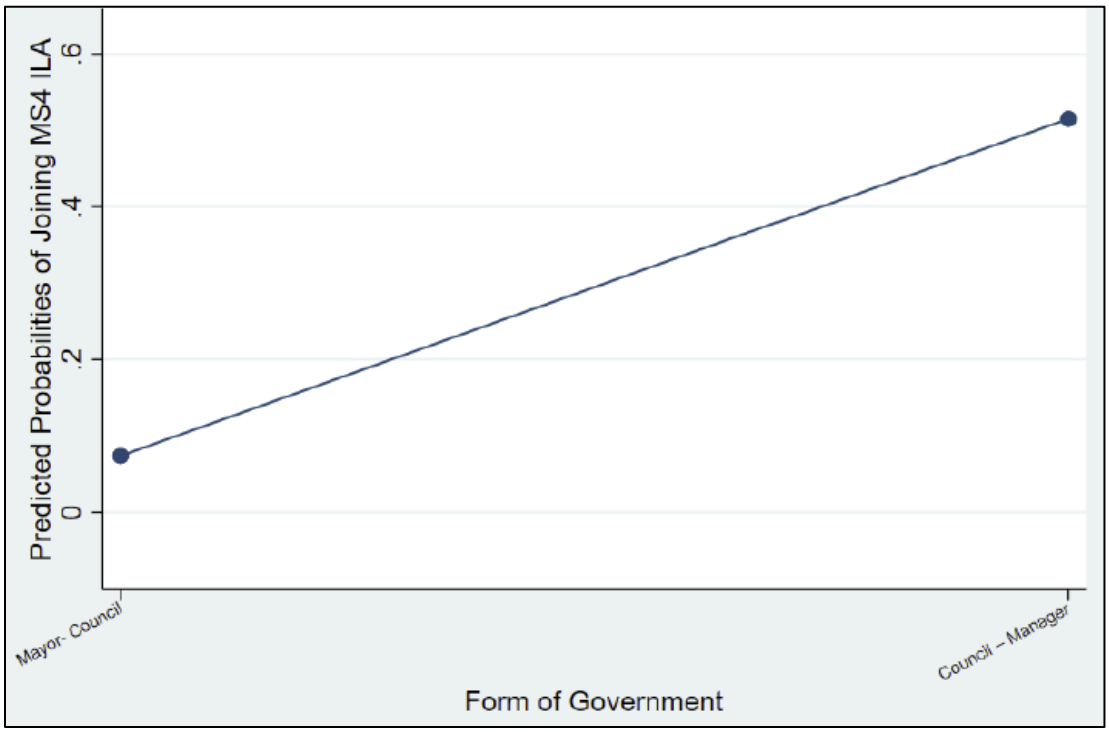


Figure 4.3: Predicted Probabilities of Joining MS4 ILA by Government Type



Among all the control variables, the form of government variable is the only one with statistical significance. As shown in Figure 4.3, the average predicted probability of MS4 city's joining MS4 ILA increases as the city moves from a Mayor-Council to a Council-Manager form of government. The study results are consistent with the results of previous studies (Krueger & McGuire, 2005; Kwon & Feiock, 2010; Shrestha & Feiock, 2011; Hawkins, 2017); it was found that managers are leaders in local cooperatives, especially in routine services. These results can be attributed to the fact that the process of meeting the requirements of the legislative burdens of stormwater management has become a routine matter for local governments, given that these legislations have been introduced and implemented for nearly three decades. Therefore, it is no surprise that the type of government positively impacts an MS4 city's decision to join an inter-local agreement to meet the legislative burdens associated with stormwater management legislation. On the other hand, it is surprising that the social homogeneity (Older Population) and

financial (Community Wealth, Public Works Spending, and Stormwater Fee) variables had no effect on an MS4 city's decision to join an inter-local agreement to meet the legislative burdens associated with stormwater management legislation. These results can be explained by the fact that the response to the stormwater legislation requires an exchange of information and experiences among local governments, in addition to financial burdens. In other words, the desire to obtain information and expertise may be one reason for entering into such contracts besides reducing the cost of compliance. Therefore, these potential drivers should be investigated in future studies.

4.6 Conclusion

This research aimed to capture local governments' use of interlocal agreements to comply with stormwater regulatory burdens imposed by federal and state policies. Two gaps were identified in the research literature: the lack of attention by interlocal cooperation literature to the factors influencing an RLG's decision to join an ILA to comply with regulatory burdens and the disagreement in the environmental management literature regarding compliance with the regulative burdens. In addition, the study hypothesized that an RLG would be more likely to take advantage of an interlocal agreement to comply with stormwater regulatory burdens if the number of neighboring cities and population density increases. Utilizing a case study of 119 cities that were subjected to MS4 permits within the Dallas–Fort Worth (DFW) region in the state of Texas, the study found statistically significant evidence to support its hypotheses, as well as statistically significant evidence for the role of government type on such decisions. These results represent an addition to the current theoretical work on interlocal cooperation by accounting for regulatory burdens as a factor leading to inter-local agreements. In addition, this paper will offer practitioners the opportunity to harness the power of local cooperative

relationships to address the regulatory burdens imposed on them by the federal and state governments. Finally, these papers provide a basis for researchers wishing to examine the relationship between regulatory burdens and local cooperation.

In addition, I am aware that the use of a case study limits the generalizability of the findings. In other words, the findings may not be generalizable to other places or different types of regulatory burdens. However, the MS4 regulations affect thousands of local governments. Conceivably, an increase in the number of cases and the size of the sample may increase the generalizability of findings. However, this study provides an overall inroad to the study of regulatory burdens as a source of interlocal cooperation beyond service delivery and of the broker role of the regional organizations in the ILA.

Finally, future research on the regulatory burdens as a source of interlocal cooperation in stormwater management should focus on other motivations associated with the contracting process, such as access to information and expertise. In addition, future research on meeting the legislative burdens associated with stormwater management should examine the role that the classification of cities plays in cooperative relationships and whether or not the Phase I cities are drivers of such engagements. All in all, future research may find this study to be a bridge connecting response to the legislative burdens with entry into interlocal cooperative relations.

CHAPTER 5

CONCLUSION

This dissertation aimed to offer an inclusive conceptualization of a multilevel governance framework that accounts for the complexities of implementing stormwater management policies. Stormwater management is one of the most important collective action dilemma problems because everyone will be affected by a wide range of negative externalities if no one stops the pollution of stormwater or everyone focuses on moving stormwater outside their boundaries quickly and untreated. Moreover, stormwater pollution has direct impacts on both the environment and society. According to the USEPA (2017), 46% of the nation's rivers/streams and 21% of its lakes are in poor condition due to stormwater and other pollution sources such as agriculture and urban development. Similarly, stormwater pollution impacts society by limiting the benefits of water used for drinking water or recreational activities. Also, stormwater can increase the chances of flooding and property damage.

One of the most important sources of stormwater pollution is urban development. The process of urban development affects the environment and changes the stormwater streams. In addition, stormwater has led to the transport of urban waste from chemicals or solid materials; thus, the failure to treat rainwater leads to the pollution of water bodies. Given this unusual transformation of natural stormwater, there have been many types of responses to this issue at a number of levels of government. At the local government level, the response has often revolved around moving stormwater outside the administrative boundaries as quickly as possible, leading to increased water flow in neighboring local governments. Further, state governments have not often interfered in the process of rainwater management. Finally, the federal government has included legislative requirements for rainwater management, embodied by Section 319 of the

Clean Water Act of 1987, which establishes a new NPDES permit requirement, the MS4.

To investigate the implementation of stormwater management regulations, this study builds on the literature on institutional fragmentation to create a theoretical framework for the proposed multilevel governance framework. This study has argued that stormwater management is fragmented both vertically (at the level of intergovernmental relations) and horizontally (within the level of governments). In terms of vertical fragmentation, there is conflict over the institutional setup that states follow in implementing stormwater policies after they assume the authority for their implementation. In the race to the bottom literature, there is an ongoing debate about the extent to which an institutional arrangement affects environmental policy outcomes. On the one hand, some argue that states will introduce a decentralizing framework to enhance competitiveness and reduce the impact of legislation on the economy. On the other hand, some argue that states will adopt a central framework that will enable them to achieve the desired policy results (increasing water quality). In the area of horizontal fragmentation, the requirements imposed by the stormwater management policy represent a regulatory burden on local governments since it requires collective action to reduce the cost of implementation first and then reduce the consequences of non-compliance by some other local governments.

Therefore, this study introduced overall conceptualization of a multilevel governance framework that accounts for the complexities associated with implementing stormwater management policies at the vertical and horizontal levels by seeking an answer to the following questions:

> Q1: How do the institutional arrangements adopted to implement stormwater policies influence variation in stormwater quality at the state level?
>
> Q2: What influences variation in ILA membership for stormwater regulatory compliance at the regional level?

Each question has been discussed through an independent research paper. The first deals with the implementation of stormwater management policies at the vertical level. This paper investigates the effect of institutional arrangements adopted by state governments to deal with stormwater quality in these states. The second paper discusses the cooperation between local governments to comply with federal/state stormwater management policies at the horizontal level. This paper investigates the factors that motivate local governments subject to stormwater regulations to enter into cooperative relations to meet the legal requirements imposed on them by state/federal governments. The proposed conceptual framework aids in understanding the complexities of implementing stormwater management policies at the vertical and horizontal levels.

5.1 Results and Implications

The results of this thesis are presented in chapter 3 and chapter 4. Chapter 3 includes the qualitative study of the institutional arrangements adopted by the state governments to implement stormwater management policies. Through a review of the research literature related to the implementation of stormwater management policies, two main gaps were identified: the first gap is centered around the failure to address the impact of the institutional arrangements adopted by the states, and the second gap is centered around the limited generalizability of single case studies. Building on the theory of local public economics and the race to the bottom literature, chapter 4 presents a qualitative study to address the gaps identified in the research literature. The qualitative study reviewed stormwater drainage permits (MS4 permits) and stormwater quality reports in four case studies: California, Texas, Virginia, and Minnesota. The study found that stormwater quality is affected by the institutional framework used to implement stormwater management policies. Specifically, the study found that the stormwater quality

increases as a result of the adoption of decentralized policies in the areas of standard formalization, coercion action, education, staff training requirements, local government contextual prioritization, and accommodation for opinions of other stakeholders at the local and regional levels. The study also found that the higher the degree of centralization in any of these dimensions, the lower the stormwater quality. In other words, there is an inverse relationship between the quality of stormwater and the degree of centralization in the adopted institutional arrangements for the implementation of stormwater management policies by state governments.

The qualitative study results presented in chapter 4 are consistent with findings from the literature that deals with the positive impacts of decentralization on environmental policies. This result is consistent with Oates and Portney's (2003) proposition that local governments should be given a degree of autonomy in implementing environmental legislation to match their local needs with the legislative requirements imposed on them by state/federal governments. In addition, the current study finds that decentralization did not have negative results. On the contrary, it contributed to achieving the objectives of the legislation in reducing pollution levels in stormwater. Thus, these findings support Sigman's (2014) findings regarding the positive effects of decentralization on policy implementation and contradict Millimet's (2013) argument regarding the negative consequences of decentralization.

Concerning the horizontal aspect, chapter 4 presents a quantitative study of the factors that influence the decisions of local governments bound by stormwater regulations to enter into cooperative relationships. Based on a review of the cooperation and stormwater management literature, it was determined that there are two gaps in this literature: the lack of attention to the issue of joining an ILA to comply with regulatory burdens and disagreement within the environmental management literature regarding dealing with the stormwater regulatory burdens.

Employing transaction cost theory to address these literature gaps, the quantitative study tested two hypotheses, the first related to the number of local governments adjacent within the geographical area of the regulated local government and the second related to the population density of the regulated local government. Using a logistic regression model to analyze a case study of 119 cities subjected to MS4 permits within the Dallas–Fort Worth (DFW) region in Texas, the quantitative study results show that an increase in the number of neighboring regulated local governments is associated with an increase in the likelihood that the regulated local government will decide to join an ILA, as well as demonstrating that an increase in the population density is associated with an increase in the likelihood of a regulated local government's deciding to join an ILA. In other words, the results of the study support the proposed hypotheses. In addition, the study found that the type of government also affects the decision to enter into a cooperative relationship to meet the regulatory burdens associated with implementing stormwater management policies imposed by state/federal governments.

The quantitative study's findings are in contrast to Morgan and Hirlinger's (1991) findings that having access to alternative providers increases the likelihood of joining an inter-local agreement. In addition, the results are at odds with LeRoux and Carr's (2007) findings that having access to alternative providers decreases the likelihood of joining inter-local agreements. On the other hand, the current study results agree with those of LeRoux and Carr's (2007) study on the effect of the population density variable as both studies found that the higher the population density, the higher the probability that an organization will engage in cooperative relationships. The study results regarding the effect of the type of government variable are consistent with the results of previous studies (e.g., Krueger & McGuire, 2005; Kwon & Feiock, 2010; Shrestha & Feiock, 2011; Hawkins, 2017); it was found that managers are leaders in local

cooperatives, especially in regard to routine services.

This dissertation calls on local government workers in sectors involved in implementing environmental policies and stormwater management policies to understand the institutional framework in which they work and the potential cooperative relations available at the horizontal level to achieve the required compliance with these policies. By knowing how centralized or decentralized the institutional arrangements in which local government officials operate are, they can align legislative requirements with the needs of their citizens. In addition, local government employees should be aware that neighboring local governments can be a resource enabling them to ease the burden of compliance with legislation imposed by state/federal governments. Combining the understanding of the institutional arrangements with horizontal cooperative opportunities will enable the local governments to achieve the required compliance and meet their citizens' needs. Ultimately, the policymaker at the state level should recognize that stormwater quality will be improved through the adoption of more decentralized institutional arrangements that allow local governments to align their citizens' needs with regulative requirements.

5.2 Contributions

Providing a conceptualization of a multilevel governance framework for understanding the implementation of public policies is one of the main contributions of this dissertation. The multilevel governance framework encompasses the vertical and the horizontal aspects of public policy implementation. With regard to the vertical aspects, this dissertation contributes to the research literature by presenting a detailed methodology for studying the adoption of institutional arrangements by states to implement public policies after assuming the authority to implement them. The use of the qualitative approach to analyze and compare institutional arrangements

contributes to highlighting various aspects of the implementation of public policies, such as the discrepancy in the formulation of standards, the use of coercive power, the educational and training needs of those involved in implementation, and the importance of taking into account the differences between local governments and the opinions of local and regional stakeholders. Each of these aspects cannot be understood in depth through quantitative methods. However, qualitative methods are sufficient to increase the understanding of this discrepancy in the institutional arrangements for implementing public policies, especially rainwater management policies.

Moreover, studying the horizontal aspects of the public policy implementation creates a bridge between the literature on cooperation between local governments and the literature interested in studying regulative burdens. By examining the factors that influence the decisions of the regulated local governments to enter into cooperative relationships to meet regulative burdens, this study provides new scope for the study of cooperative relationships outside the context of public service delivery. In other words, this work moves the study of cooperation between local governments from a framework of cooperation to provide services to a framework of cooperation to meet the legislative burdens imposed by the state/federal governments. As far as I know, this is the only study linking legislative burdens and cooperation, at least in the field of public policies related to stormwater management.

5.3 Limitations

This dissertation has presented a multilevel governance framework for understanding the implementation of environmental policies in general and stormwater management policies in particular. However, the presented framework faces some limitations. Starting with the qualitative aspects related to the study of the relationship between institutional arrangements and

policy outcomes, there are challenges in the discrepancies found among the methods of monitoring water quality in the reports of the states under study. According to Keller and Cavallaro (2008), each state measures and monitors water quality differently. These differences may be among the most important threats to the generalization of the comparisons among the performances of the states. Therefore, the current study controlled for this threat by comparing each state's results independently via the comparison of a previous report with a later report. Another threat to generalizing the results is that the study sample is small (including only four states), and thus it may be impossible to generalize the results to all states. Therefore, one of the opportunities for future study is to investigate the possibility of a direct comparison of the quality of rainwater among states. In addition, a future study can increase the sample number to improve the generalizability of the results.

Similar to the qualitative study, the quantitative study suffers from a threat to the generalizability of its results. The study sample is small and limited to a specific place and time. The study sample included only 119 cities in the north of Texas and belonging to one metropolitan area. The study sample lacks diversity among its members regarding geographical location and may not represent all the MS4 cities in the United States. On the other hand, there are no data available on the national level or the whole of Texas regarding cooperative relations of the MS4 cities. Therefore, future studies can improve the generalizability of results by including a more representative sample of the study population.

All in all, stormwater management is a problem of collective action that has received great interest from legislators, researchers, and workers in the environmental sector. Although policies have been envisaged to reduce stormwater pollution, the problem continues to the present time and will continue along with continued urban development. However, the existence

of policies by themselves is not sufficient without finding appropriate arrangements for their implementation. Moving forward, for researchers and workers in this field, the proposed multilevel governance framework will facilitate a deeper understanding of implementation and compliance with stormwater management policy. Finally, the issue of stormwater management needs further research and investigation.

APPENDIX

THE EVOLUTION OF WATER POLICY IN THE UNITED STATES

Legislation	Period	Aim
State or local common laws	The late 1700s to Early 1850s	Flood control and water resource issues
Swamp Land Act	The 1850s	Flood control and water development
Mississippi River Commission	1879	Flood control and water development
Rivers and Harbors Act	1890	Flood control and water development
General Mining Act	1866	Water resource allocation
National Irrigation Association	1899	To accelerate federal construction of reservoirs in the West
Reclamation Act	1902	To authorize federal funds for the construction of reservoirs and water distribution facilitation in sixteen western states, with federal loans being paid by the farmers. The act protected state water rights; accordingly, the priority dates for water rights for reclamation projects are set in accordance with the law of the state where the water is diverted for the project.
Federal Power Act	1920	This act licenses nonfederal power developments on navigable waters in the public domain and management of the sale of surplus power generated from federal dams.
Rivers and Harbors Act	1925	To authorize the U.S. Army Corps of Engineers to survey all navigable waters and formulate general plans for irrigation, navigation, power production, and flood control
Tennessee Valley Authority	1933	Developing the river for the benefit of the people
National Resources Planning Board	1943	Executive coordination of water resources
Water Pollution Control Act	1948	To reduce water pollution by point source discharge of industries
McCarran Act	1952	To waive the sovereign immunity of the federal government and make state courts the forum for federal water claims
Water Resources Council	1961	An interagency data-gathering and policy body designed to provide presidents with water policy advice

Legislation	Period	Aim
Arizona v. California	1963	The U.S. Supreme Court recognized federal proprietary water rights.
Water Resources Research Act	1964	To initiate the creation of water research centers at universities across the United States
Water Resources Planning Act	1965	To attempt integrated water management and planning
Water Resources Council	1965	A cabinet-level interagency planning and coordinating body
National Water Commission	1968	To focus on conservation and water quality
Federal Flood Insurance Act	1968	To limit the types of buildings that can be insured on flood plains, allowing only those that can withstand periodic flooding without damage to be insured
Clean Water Act	1972	To establish a permit system for the discharge of pollutants, to be administered by the U.S. Environmental Protection Agency (EPA). To establish minimum principles and requirements that apply nationwide, supported by the federal government's authority over navigable waters under the commerce clause of the U.S. Constitution
Pacific Northwest Electric Power Planning and Conservation Act	1980	To establish the Northwest Power Planning Council
Northwest Power Planning Council	1980	To strike a balance between energy needs and conservation of fish and wildlife in that region
Water Resources Development Act	1986	To increase responsibilities for states but decrease funds. New 50 percent cost-sharing requirements for Corps and Reclamation projects. To withdraw funds for water resource activities as sewage treatment plants, water development projects, dam safety programs, and water data collection
Clean Water Act	1987	A new funding strategy addressing water quality needs by building on EPA-state partnerships. To establish the National Estuary Program, a collaborative watershed approach for protecting coastal water quality
California v. Federal Energy Regulatory Commission	1990	U.S. Supreme Court ruling that state law cannot supplement federal flow requirements

Legislation	Period	Aim
The Reclamation Projects Authorization and Adjustment Act	1992	To decrease water flow to irrigation in California's Central Valley Project (CVP)
Water Resources Development Act	1992	To provide federal funding for the restoration of Kissimmee River in Florida to its original meandering course
Energy Power Act	1992	Includes conservation measures such as water efficiency standards for faucets, showerheads, and toilets
Safe Drinking Water Act	1996	To give states more funding to comply with environmental standards and flexibility to exercise authority over drinking water standards and their enforcement
Water Infrastructure Finance and Innovation Act	2014	To establish the Water Infrastructure and Resiliency Finance Center to provide local governments and municipal utilities with financing mechanisms

Source: Dolowitz (2015), Copeland (2006), Gerlak (2005), Adler (2009b), Baker (2009a).

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